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Aerial Strategies and their Effect on Conflict Characteristics

by

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ABSTRACT

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This project asks the question of how different aerial strategies can affect the characteristics of aerial campaigns in conflict. It begins be developing a new categorization of aerial strategies that distinguishes aerial strategies by how targeted they are. Data is collected on the type of strategies that were used in aerial campaigns from 1914 to 2003. A preliminary analysis of aerial strategy choice is conducted, studying the effect of military doctrines on strategy choice. The project also takes into consideration the role that ground forces, both those of the state carrying out the aerial attack and of its opponent, will play in determining the effect of aerial strategies on campaign duration and outcome.

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CHAPTER 1: INTRODUCTION

In October of 1911, during the Italo-Turkish War, Italian pilot Giolio Gavotti flew an early model of the Etrich Taube aircraft (a small monoplane that, was used as a bomber, fighter, trainer, and surveillance aircraft) over present-day Libya. From it he dropped four bombs on Turkish bases (Italy and Turkey were fighting over control of this territory). Gavotti's mission, though likely not key to the outcome of the war, is claimed by some to have been the first aerial bombardment mission in history (Gropman n.d.).

Despite the limits of early bombing campaigns, air power strategists and scholars immediately recognized the potential that air power had for expanding the range of targets in conflict. Suddenly it was no longer necessary to defeat ground defenses in order to attack key population and industrial centers. Whereas before these key targets were only available to states that had militarily defeated the opponent's ground troops, air power expanded the possibilities that states had available to them in conflict. States were of course not completely defenseless and exposed to aerial attacks (as some, such as Douhet [1922], might have originally predicted). With the development of combat aircraft came air defenses as well, and fighter tactics against bombers. Still, there is no denying that since then, states (and particularly major powers with the capabilities to build air forces) have made the achievement of air superiority a key part of their military doctrines.

Besides expanding the range of targets, air power provides for the possibility of "clean" victories. In other words, it offers leaders a tempting possibility of achieving a low cost (both in terms of casualties and the magnitude of the resources devoted to the attack) victory in conflict. Air power is thus often thought of as a low-risk and low-cost

alternative to committing grounds troops to a conflict (Byman, Waxman and Larson 1999).

Interestingly, almost exactly one-hundred years after the Italians carried out that first aerial bombardment in Libya, another Libya campaign captured the world's attention. After the U.N. approved the creation of a no-fly zone in Libya, in March of 2011 NATO began an air campaign that was intended to support the rebel Libyan groups fighting on the ground against the regime of Muanmar Qaddafi. Within less than a year, the rebels had succeeded in toppling the Qaddafi regime, NATO had had no formal large-scale presence on the ground[1], and no NATO military personnel had been killed in the campaign. Also importantly, the leaders of these states, such as the United States' Barack Obama, had engaged in the military intervention without strong political opposition from their constituents[2]. While there is no way of knowing this for certain, it is likely that opposition to the deployment of U.S. troops to a third war would have been much greater than it was for the Libya bombing campaign.

Air-only military campaigns, such as the one in Libya, come with a low-level of commitment, making it much less risky for a state to get involved in a conflict. In other words, withdrawing from a conflict, if the state chooses to do so, is much easier than if ground troops are involved. Of course, as critics of the Libya NATO operation remarked, it is precisely this lack of commitment that has been speculated to make such operations ineffective. Critics argue that air power on its own cannot coerce an adversary into

[1] While there was no formal NATO ground presence, the alliance did employ forward air control teams on the ground to help guide aircraft to its targets**Invalid source specified.**.

[2] It should be noted that Obama did face some criticism from his political opposition, but much of it focused on the length of the campaign and whether he should attempt to repeal the War Power Act. The opposition was nowhere near as strong as it was for the Afghanistan or Iraq wars.

changing its behavior in the way that a ground intervention (which can include post-conflict nation-building) would (Bosco 2011, S. M. Walt 2012).

Politics and Air Power

Military strategies can be designed to disarm the enemy completely, making it impossible for the opponent to continue fighting. More relevant to the study of politics, military strategies can also be designed to influence the expectations of the opponent on what the outcome of an absolute war would be, if it were to be fought. Besides destroying the resources of the opponent, and altering the balance of power, military strategies can be used to reveal information about military capabilities. Thus, in most wars the decision to end a war is a political one, made by leaders, rather than a military one made when one side is completely defeated by the other (Blainey 1973, von Clausewitz 1976, Wagner 2000).

Air power in particular can serve both to destroy the resources of the opponent and to signal the potential cost of continuing to fight. This depends, of course, on how air power is being used. In this dissertation I will study not just whether air power is being used in conflict, but rather how it is being used. In other words, I will study different aerial strategies and how the choice of strategy can affect how a conflict plays out, as well as how it ends.

Before further introducing this work, I will discuss what I am referring to by military strategy. Military strategy has been defined in a variety of ways, even within the international relations literature. In general, though, when we speak of military strategy

we are referring to the way in which states use the resources they have to achieve their aims.

Military strategy has been studied at a variety of levels. For example, we can study grand strategy, which refers to the ultimate ends and means of war and relates the political, diplomatic and economic realms with the military (Luttwak 2001). At the opposite end of the spectrum is the study of tactics, which refers to the actual combat taking place, including the positioning of weapons and exploitation of the terrain. In this dissertation I will be studying military strategy at the *operational level*, which is the following:

The overall methods of war, the level of battle as a whole and the style of war (Luttwak 2001).

The level "concerned with how to achieve the strategic ends of the war with the forces allotted." (Warden 2000, 2)

In this dissertation I will adopt a definition of *military strategy* similar to that used by Reiter and Meek (1999), which is in turn taken from Liddell Hart (1962). For this dissertation, I will refer to military strategy as:

The way in which military forces are employed in order to achieve a policy objective (Liddell Hart 1962, Reiter and Meek 1999).

The Project's Structure

I begin to think about the influence of military strategies on outcomes by thinking that a state has a set of aerial strategies available to it. Given this range of options, the state will select the strategy that provides it with the highest number of benefits, taking the costs of using the strategy into account. In other words, the state will choose the strategy that maximizes its utility. Given that a state has made this choice, the question I then ask is how this choice of strategy will affect the development and outcome of the bombing campaign.

The first question that I address is how to categorize aerial strategies. Previous work on air power has drawn a distinction between military and non-military targets. As the case of another NATO campaign, the one in Kosovo, shows us, though, more subtle distinctions can be made between different strategies of aerial bombing if we want to understand which ones are more likely to lead to victory. When NATO allies engaged in an aerial campaign to stop Slobodan Milosevic's violence against the Kosovars, NATO explicitly made it clear that no ground forces would be committed to the effort. Less than three months after the air campaign began, Milosevic capitulated, making the air campaign successful. Though some would argue that the reason Milosevic was coerced was because of the threat of a NATO ground invasion (despite their statements, Milosevic could have had reason to believe that NATO troops were ready to invade), it is also true that NATO's particular choice of targets may have led to Milosevic stepping down. Besides bombing military targets that made it difficult for Milosevic to continue the war effort, NATO also chose targets that were of financial importance to Milosevic (NATO chose to bomb industrial targets that were specifically owned by either Milosevic

himself or by his family). Thus, this choice of targets made it costlier for Milosevic to continue the war effort (Stoll 2011). In the case of the bombing campaign in Kosovo, it wasn't only the fact that industrial targets were being bombed, but that the particular targets that were chosen were important to Milosevic.

This dissertation will attempt to fill a gap in the literature by providing a new categorization of air power that goes beyond choosing civilian or military targets and instead focuses on the choice of targets within each of the two categories. I will also make a distinction between air power used for close air support, interdiction, and strategic attack. This will enable the application of the same sort of theories that one would use for studying ground strategies to air power, while at the same time recognizing the different nature of air power.

The main question asked in this project is how these different choices of aerial strategy can affect the characteristics of a military campaign. Of course, when considering the effect of military strategies on conflict outcomes, one potential caveat is that the choice of military strategy is endogenous to the conflict at hand. In other words, when states are faced with a choice of strategies, they will choose the one that will make them more likely to win the conflict. This leads to results that will therefore not be generalizable. The argument that I will make in the first analytical chapter of this dissertation is that all possible strategies are actually not available to states when they are making a decision of which strategy to use. I argue that states will be either unable or unwilling to use certain military strategies, being bound by their military doctrines.

Having provided some evidence for this argument, I move on to explore how aerial strategies interact with forces on the ground to affect the duration of aerial

campaigns, both in the cases of success and defeat. While there are certainly cases of air-only campaigns, most uses of air power in conflict are carried out either in support of or in coordination with ground forces. As Horowitz and Reiter (2001) state, air power often works best when coupled with ground forces (perhaps this is why air-only operations are such a rarity). While much of the previous international relations work on the use of air power has focused on it independently of ground power, I argue that we should not be thinking of air power in isolation, but in conjunction with what is happening on the ground.

At the same time, the opponent's strategy may also influence the effectiveness of air power, regardless of the type of air power being used. Susan Hannah Allen, in her 2007 piece on bombing campaigns, concludes that guerrilla tactics used by the target make bombing less successful, suggesting that there is a need for an increased focus on the actions of the target, along with those of the attacking state. I thus devote my third analytical chapter to exploring how both the characteristics of the opponent and its military strategy can affect the outcome of aerial campaigns.

The following chapter discusses selected literature on conflict outcomes, military strategy, and the use of air power in conflict. It will identify where in the literature this dissertation will fit, as well as the gaps that it will attempt to fill. Chapter 3 will set up a general theory of military strategies in the air, as well as develop the classification of air power that will be used in this dissertation. Chapter 4 further develops the theory and lays out the research design that will be used in further chapters to test a variety of hypotheses. Chapter 5 discusses how it is that states select their aerial strategies, focusing on the role that military doctrine plays in this choice. Chapters 6 and 7 will in

turn be devoted to the analysis of the effect of different air strategies on aerial campaign duration and outcome, considered (respectively) relative to grounds strategies, and relative to the strategy and characteristics of the opponent. Chapter 8 is the conclusion.

The general aim of the project as a whole will be to explain how different uses of air power can affect the outcome of an aerial campaign, as well as how the campaign plays out. I will do this by distinguishing between more and less targeted aerial campaigns, as well as by taking into account the role that ground power (both that of the state conducting the aerial campaign and of its opponent) can play in influencing the duration and outcomes of aerial campaigns.

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CHAPTER 2: LITERATURE REVIEW

When we think about the most effective way of using air power in conflict we have to think about placing it in the context of the study of conflict. One of the main questions to answer in this dissertation will be what the effect of different forms of air power is on outcomes during conflict (under various circumstances) [3]. This means that one of the questions that we must consider is how war outcomes are determined.

War and the Revelation of Information

Recently, much of the International Relations literature has studied war initiation from a bargaining point of view. From this point of view, being involved in a war at all is an inefficient outcome, as the same outcome could always be reached by both states through bargaining, without having to incur the costs of fighting the war (during which resources are inevitably destroyed) (J. Fearon 1995). Yet, in this framework we can explain war between two rationalist states when there are issue indivisibilities (though this explanation can mostly be argued away through the use of side-payments and issue linkage), incentives to keep information private, or commitment problems (J. Fearon 1995). In these cases, war may still happen even though during the bargaining process there was a non-empty bargaining range that was mutually preferred to war. As Powell (2004) explains, fully-informed states may find themselves in war when states use war to "lock in" a certain payoff that they may no longer be able to obtain in the future. If the sum of both players' lock-in values is greater than the amount that can be divided through

[3] Note that I will also be discussing the duration of aerial campaigns, but, as will become evident later on in this project, this will be done in an attempt to also understand the outcomes of aerial campaigns.

negotiation, then there will be no agreement. Thus, large shifts in the relative bargaining power of the players may make the player that expects to be weaker in the future take its lock-in payoff now, since the other player cannot commit to give him something better in the future. This approach to bargaining and war views war as a costly lottery, where the outcome of it is predetermined through a given probability that is known to both actors.

The Ending of Wars

If we think of war as a costly lottery, then we know that it will end at some point, as well as the probability with which each state will win the war. What this approach does not tell us much about is the process that will lead to the end of the war. If we follow the war-as-bargaining framework, we can think of war as ending when the issues that led to the initiation of war are resolved. This means that wars will end either when enough credible information is shared that there is an agreement between the two states as to what a settlement will be, or when the commitment problems that led to the initiation of the war are resolved (J. Fearon 1995).

There is another current in the bargaining and war literature that specifically models how wars serve to reveal information about the two states in conflict, thus allowing states to reach a settlement that wouldn't have been possible without first fighting the war. Generally, this work moves away from the war-as-a-costly-lottery assumption and instead models war as a continuation of bargaining. Wagner (2000) specifically seeks to answer the question of why in some cases agreement is possible after fighting but not before. His reasoning is that states might expect to get a better bargained settlement if they fight, even if this would not improve their military position. Wagner

(2000) explains this logic through a bargaining model in which he draws a distinction between absolute wars (ones in which the aim is to entirely disarm the opponent) and real ones (in which the main aim is to influence the terms of the agreement that will be accepted). Military operations serve the functions of revealing information about capabilities and also of destroying the capabilities of the adversary. In real war, according to Wagner (2000), states can have similar military capabilities, but one state may believe that superior war-fighting capabilities (morale, tactics, training, etc) will give it an advantage in fighting battles. The other state, though, is unsure as to whether this belief is true or not. If the two states fight a battle and the first state wins, then the probability of the belief being true, as perceived by the second state, increases. Thus, a state that wins a battle can expect a more favorable offer from its opponent (Wagner 2000).

Another work that models the end of war happening as more information is shared is that of Smith and Stam (2004). Smith and Stam share Wagner's (2000) viewpoint that very few wars are actually fought until one or both sides are completely disarmed. They instead model war as a random walk model of conflict, in which states capture "forts" from each other and continue until one side has lost all of its forts or until a negotiated settlement is reached. A key feature of this model is that Smith and Stam relax the assumption of common priors. That is, even absent private information, actors have heterogeneous beliefs that lead to disagreement. As more information is revealed through battles and the acquisition and loss of forts, beliefs converge. In a way, Smith and Stam (2004) are revisiting Blainey's 1973 argument, which argues that state leaders use war to assess their ability to impose their will on their rival. Wars thus begin when

two nations disagree on their relative strength. When the war has helped the states assess their ability to impose their will on their rival, and they now agree on their relative strength, the war comes to an end.

One major point behind these works is that if wars begin because of information asymmetries, then fighting the war serves to provide information and thus resolve the war. Beyond information asymmetries, though, the rationalist theories of war also state that wars begin because of commitment problems. Because states cannot credibly commit to a settlement that they would both prefer to war, they fight. Thus, according to Reiter (2009), wars can also end once the commitment problem is resolved. One way in which the commitment problem can be resolved is by defeating the adversary in an absolute war. If a state is able to impose on its opponent an outcome such as the annihilation of the population, the annexation of its territory or a regime change, then it will prevent the adversary from attacking it in the future, and thus remove the possibility of the opponent reneging on the agreed settlement (Reiter 2009). Reiter (2009) makes the point that when commitment problems are very severe, not even negative information from the battlefield will keep states from continuing to fight and to seek an absolute victory.

The question that then comes to mind is why all wars are not absolute ones. After all, we can observe several cases in which states are able to reach a settlement without either side necessarily achieving an absolute victory. Under this rationalist framework of war settlements, sometimes the information dynamics will dominate, such that the states are able to exchange enough information through battle that a new balance of power is agreed upon and a settlement can be reached. Of course, this agreement can always

break down if one side believes that by restarting the fight it can achieve a more favorable settlement. Reiter (2009) identifies three cases in which this breakdown is most likely to happen: 1) under a post-war shift in the balance of power, 2) if there is a first-mover advantage that would give one side an incentive to launch a surprise attack, and 3) when new leadership comes to power.

Commitment problems may also be overcome if one of the belligerents finds that its prospects of achieving absolute victory are so low that it is willing to accept a settlement, even if it is not credible. Also, Reiter (2009) argues that fighting an absolute war is a luxury that not all states can afford. If fighting becomes too costly, states may be willing to accept partial settlements. Commitment problems may also be ameliorated by the presence of peacekeeping troops, or by capturing goods that may be helpful in maintaining the credibility of the settlement (such as strategically valuable territory that facilitates defense) (Reiter 2009).

The Determinants of Conflict Outcomes

This previous framework allows us to understand the mechanism through which wars can both begin and end between rationalist states. Still, if we want to understand why a particular war outcome happened, we should also be thinking about how states were able to credibly reveal information and/or overcome their commitment problems. In other words, we know that wars will end when one state convinces the other that it is more powerful or when one state defeats the other absolutely or manages to solve the commitment problem in another way that allows for a partial settlement, but what we still need to better understand is how states are able to transmit this information to convince

their opponents of their superior capabilities, or how they manage to overcome the commitment problem.

When considering how states can credibly assert their superiority, both from a policy as well as a scholarly perspective, we first and foremost think about the material capabilities of the combatants involved in the conflict. Starting from a realist point of view, material resources will determine the power balance between two states, and thus the outcome of a conflict (Mearsheimer 2001, Waltz 1979). It is an easy (and uncontroversial) statement to make that all else being equal, the state with the greater capabilities will be more likely to prevail in a conflict. Just about every single study that considers the outcome of a conflict, from the formal theory (Morgan (1994), to name one example) to empirical studies (Sullivan (2007), to name another), considers the military capabilities of the states involved in a conflict. Still, while military capabilities may be our most obvious and necessary variable to study war outcomes, it is also true that if it were the only variable at play in determining the outcome of a war, there would be no uncertainty involved in conflict, and hence no need to actually fight wars, only a need to compare military capabilities. Thus, in the international relations literature, the effect of a large number of variables (many of them intangibles that are likely to lead to uncertainty) on war outcomes has been considered.

Military alliances are a major factor that can determine the balance of power and thus the outcome of conflicts. Traditionally, the process through which alliances were considered to affect the outcome of a conflict was very similar to that of capabilities. This is because the most basic way in which alliances were considered to affect war outcomes was by aggregating (and hence increasing) capabilities. In traditional work on

alliances, the alliance represents the aggregation of the capabilities of the individual member, and it is joined in order to balance against aggressors, by making it more likely that the members of the alliance would prevail in a conflict with an aggressor (Waltz 1979, S. M. Walt 1987). More recently, the basic aggregation point of view has been called into question. For example, Powell (1999) has suggested that the aggregation of military capabilities in alliances may result in increasing, constant or decreasing returns to scale. Bensahel (2007) argues that alliances will actually decrease military effectiveness by imposing transaction costs that are the result of integrating different troops. Still, countries engage in war-fighting through alliances because of the political benefits of fighting a multilateral war that in the end make success and the achievement of their aims more likely (Bensahel 2007). This implies that if the effect of an alliance on the outcome of a conflict is more uncertain, a war will have to be fought in order for states to know what the effect of the alliance will be on the outcome of the war. Reiter (2009) also discusses how the expectation of having an ally join a war may convince a state to keep fighting even after military defeats, or how a potential ally joining the opposing side can decrease the hopes for victory enough that states are willing to accept even non-credible settlements.

Moving beyond a focus on the capabilities of the opposing sides, we can also think about how the different institutional set-ups of the two opposing sides may affect the outcome of a conflict. One theory in the quantitative study of international relations discusses how the type of government of a state may affect how well it performs in battle, and thus how it can persuade the opponent of its superior capabilities (Reiter and Stam 2002, Lake 1992). Though it used to be the conventional wisdom that democracies could

not handle casualties and therefore could be defeated in war if the enemy was only able to inflict enough casualties upon them[4], there is now an opposing belief that democracies may actually be more likely to win the wars they fight. Part of the reason for this may be that, due to their nature, democracies possess greater natural wealth and devote more resources to national security, as well as coming to each other's aid when one is attacked by another state (Lake 1992).

According to Reiter and Stam (2002), the effectiveness of democracies at winning wars comes from two different mechanisms, a selection and a war-fighting effect. The selection effect follows from the fact that democracies will become involved only in the wars that they feel confident of winning. Because democratic leaders have to rely on the support of the population to stay in power, if they are not able to provide the public good of victory they will most likely be removed from power (Bueno de Mesquita, et al. 2003, Reiter and Stam 2002). Though the outcome for the deposed autocrat may be worse than for the democratic leader (one obvious example being the fate of Benito Mussolini after the Axis powers lost WWII), it is also the case that autocratic leaders may be able to "buy off" those supporters that matter and be able to stay in power even after losing a war (Bueno de Mesquita, et al. 2003). Democratic leaders, knowing this logic, will thus fight only the wars that they are likely to be victorious in (Reiter and Stam 2002). In particular, democratic leaders will also be more likely to select the wars that are likely to be short and low-cost (Bennett and Stam 1996).

Beyond democracies selecting themselves into the conflicts that they are most likely to win, it is also a possibility that, once democracies find themselves in war, they

[4] This is the logic that Ho Chi Minh seems to have followed when he stated to the French that while they could kill ten of his men for every one he killed, he would still win.

may fight more effectively, through what Reiter and Stam (2002) term the "war-fighting effect." The argument is essentially that democratic troops are likely to come from more meritocratic and efficient militaries (much of this efficiency stemming from the free flow of information that is available in democracies) that in turn perform better in the field (even when capabilities and technology are controlled for). Enemy troops are also more likely to surrender to a democratic enemy (as opposed to fighting to the last soldier), as they expect to be treated better by democratic captors who are more likely to observe international norms when it comes to the treatment of prisoners of war.

Research has also explored what particular characteristics of democracies are the ones that are leading to this advantage in the effectiveness of fighting. According to Biddle and Long (2004), who study the effect of democracy on battle outcomes, once human capital, positive civil-military relations and Western culture (all factors that contribute positively to victory in battle) are controlled for, the effect of democracy actually switches. Of course, positive civil-military relations, high degrees of human capital and Western culture are all correlated with democracy. If democracy indeed causes these factors, then the idea that democracy leads to effective war-fighting would still hold, and Biddle and Long's (2004) ideas would merely be explaining the mechanism through which it does so. If these factors cause democracy, though, it may be more important to study these unit-level traits of states (as opposed to their political systems) when evaluating their effectiveness in war.

Also, it may not be the case that initial assessments of democracies' aversion to casualties were completely wrong. Bennett and Stam (1998) argue that democracies are by nature more sensitive to public opinion. As public support will decrease as the war

progresses, they argue that democracies select themselves not only into wars that they can win, but into wars that they can win easily. The longer a democracy fights, the more its support erodes, such that by the second year of the war, an autocracy is more likely to win the war. Seeing as most wars are short, though, democracies are able to retain their advantage at war (Bennett and Stam 1998).

Similarly, other work has examined the effect of a variety of other domestic factors (several of them correlated with democracy, but not all) on military effectiveness, and by extension on the probability of a positive outcome in conflict (military effectiveness can lead to both an absolute victory or to enough information being shared to convince the opponent that it will not be able to prevail in the conflict). The assumption behind these works (which is similar to that of those which study the effect of military strategy on conflict outcomes), is that the way in which a conflict is fought matters, and that domestic factors may have an influence on how militaries conduct their fighting on the field. For example, Reiter (2007) argues that a nationalistic culture, while it may open the possibility of using a greater variety of tactics (such as suicide attacks, for example) by making soldiers more willing to kill and be killed for their country, also decreases the probability of victory, by making enemy combatants less likely to surrender (nationalistic troops are more likely to demonize the enemy, giving their opponents an expectation of not being treated well if they are captured).

As mentioned before, particular domestic institutions and social structures may also have an effect on the outcome of a conflict. Hoyt (2007), for example, argues that states in which discrimination is institutionalized and are plagued by discriminatory policies against certain sectors of the population may still be able to mobilize large

numbers of forces, but that the discriminatory structure of society will translate into low skill and less integration of military units. This in turn leads to a decreased effectiveness in combat. Similarly, competition for military control between military and civilian leaders may lead to a lack of information-sharing and honest assessment of the military, again resulting in poor military performance (Brooks 2007). Even factors such as constitutional arrangements, often not even studied in International Relations, have been suggested as contributing to the outcomes of conflict (often through their influence on the effectiveness of troops). For example, Avant (2007) suggests that parliamentary versus presidential democracies face a trade-off when it comes to the military effectiveness of their troops. The institutions of a presidential system emphasize individuals, thus leading to militaries that are allowed more autonomy and thus have higher skill levels. In parliamentary systems, where unity and coordination are key to maintaining power, the militaries may lack autonomy, but have higher levels of integration and responsiveness (Avant 2007).

Military Strategies and Conflict Outcomes

All of these previous works can be integrated generally into a theory of rationalist war termination, as all of the mentioned independent variables can serve to increase the military effectiveness of a state. A more militarily effective state will in turn be more likely to both easily provide credible information about its ability to prevail in a conflict and to be able to impose an absolute victory on its opponent.

One particular independent variable that affects military effectiveness, and that I am interested in studying the effect of on war outcomes, is military strategy. As stated in

the introductory chapter of this dissertation, when I refer to military strategy I am referring to **the way in which military forces are employed in order to achieve a policy objective** (Reiter and Meek 1999). Military strategy is a key, non-capability factor that may affect both a state's decision to go to war, even when the military balance may be stacked against it, as well as its decision to continue fighting or agree to a settlement. As both Blainey (1973) and Fearon (1995) argue, states go into war with mutual optimism in victory. Often this optimism is based on the idea that even though the opponent may have an advantage in capabilities, one's troops are better trained, more motivated, or can achieve a swift victory through the use of surprise that will negate the opponent's advantage. Thus, even states with the same information may have different priors as far as the war's outcome goes, because they believe that they are able to fight more effectively (Smith & Stam 2004).

At the tactical[5] level of war the focus is on the capabilities of the two opposing armed forces, as well as the terrain and the circumstances that the armed forces find themselves in during combat (Luttwak 2001). Once we move on to the operational[6] level of war, though, the methods of war begin to have more influence. As Luttwak (2001) states, the operational level goes beyond being a sum of the different parts. It is rather about the *style* of war that is being fought. Studying military strategy and how it can influence war outcomes, even independently of material capabilities, may go a long way in helping to clarify the rationalist framework of war.

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[5] The tactical level of war refers the level in which "battles and engagements are planned and executed to achieve military objectives assigned to **tactical units or task forces**" (emphasis added) and which focuses on the arrangement of forces relative to each other and to the enemy to achieve combat objectives (Luttwak 2001).

[6] The operational level of war refers to "the overall methods of war, the level of battle as a whole and the style of war" (Luttwak 2001).

One earlier, and influential, piece that asks the question of how state leaders' decisions to go to war can be affected by the projected outcomes of the conflict is Mearsheimer's "Conventional Deterrence" (1983). In this book Mearsheimer studies what factors would lead one side to believe that it could be victorious in battle. One such factor that he considered was military strategy (in Mearsheimer's case he differentiates between attrition and blitzkrieg strategies). Mearsheimer (1983) argues that the effective use of a blitzkrieg strategy can lead to a higher probability of victory in war, by allowing states to overcome disadvantages in material capabilities.

Military strategies affect the cost benefit analysis of the two sides engaged in conflict. A particular choice of military strategy can affect the costs incurred by the opposing side, and thus their willingness to continue fighting the war (as Reiter (2009) states, if costs of fighting are high enough, states may even be willing to accept non-credible settlements). The choice of strategy may also affect the rate at which costs are being imposed on the opponent (Bennett and Stam 1998, Stam 1996). For example, a punishment strategy depends on inflicting high-enough costs on an opponent that lead to decreased support for the conflict before the opponent can adapt to these costs, thus leading the opponent to surrender, while a maneuver strategy depends on inflicting costs on the opponent at a very fast rate (Bennett and Stam 1998, Stam 1996). Of course, the effect of strategy on the cost-benefit analysis of each side involved in a war depends also on what the opponent is doing. The effectiveness of a particular military strategy may be heavily dependent on the strategy of the opponent (Stam 1996, Bennett and Stam 1996, Bennett and Stam 1998). For example, according to Stam (1996), the most desired outcome for a state that is on the offensive is to use a maneuver strategy against an

attrition strategy, while a state on the defensive would prefer to use a punishment strategy against an attrition strategy.

In 2004's Military Power, Stephen Biddle also suggests that the particular military strategy that is chosen by the warring nations will affect the outcomes of military conflicts. He begins by asking what causes victory and defeat in modern battle. Biddle (2004) expresses dissatisfaction with the way in which International Relations scholars measure the concept of military power. He seeks to explain the outcome of wars while focusing on one particular non-material independent variable—what he terms "force employment" ("the doctrine and tactics by which armies use their material on the field" (S. Biddle 2004, 2)). Biddle (2004) asserts that an approach based solely on material capabilities will underestimate the performance of what he refers to as the "modern system" while overestimating the performance of well-equipped armies that nonetheless are ineffective in using their equipment. More specifically, Biddle defines the modern system as "a tightly interrelated complex of cover, concealment, dispersion, suppression, small-unit independent maneuver, and combined arms at the tactical level, and depth, reserves, and differential concentration at the operational level of war" (S. Biddle 2004). Biddle's distinction between the modern and non-modern systems will be particularly important to this dissertation, as I will derive a categorization of air power that is largely based off of Biddle's distinction between the modern and non-modern systems. This will be further explained in the theory chapter.

Biddle tests hypotheses derived from his theory through indirect statistical tests, using case studies, statistical analysis and computer simulation (using a Defense Department combat simulation program). A problem with using case studies is that they

can lead to biased results, as researchers (sometimes even unintentionally) will tend to choose cases that are more likely to be supportive of their theories. Also, often the best-known cases, the ones that there is the most information available for, are atypical ones that may not represent the universe of cases. To address this problem, Biddle selects his case studies on the basis of them being critical cases. By critical cases he is referring to cases that have extreme values for the independent values under consideration. In particular, Biddle (2004) chooses two cases (Operation Michael, the German offensive of the Second Battle of the Somme in WWI and Operation Goodwood, the Allied attempt to break out of Normandy in July 1944) that represent most-likely cases for orthodox theories of capability and least-likely cases for his theory of modern force employment. In other words, in these particular cases the orthodox theory of capability should be on its strongest ground and the theory of modern force employment on its weakest ground.

In the spring of 1918, during WWI, in what became known as the Second Battle of the Somme, the Germans changed their approach from a defensive one to an offensive one. In what was known as Operation Michael, the Germans planned to lead an assault against the southern wing of the British Expeditionary Force, relying on an artillery attack and then an infantry assault led by German storm troopers. In the case of Operation Michael, weapon technology marginally favored the British and the force-to-force (attacker forces: defender forces) and force-to-space (defender's troop density) ratios favored the defense (in this case, the British). This means that we should have expected an easy victory for the British. Rather, the operation was a German success. Biddle explains this victory by the fact that the Germans were using the modern system in their force employment, while the British failed to effectively implement the modern

system. He similarly explains the case of Operation Goodwood in World War II. After the D-Day landings of 1944, the Allies had managed to penetrate the European continent, but they were finding it difficult to break out of Normandy. Operation Goodwood was one of the British attempts to break through the German defenses and advance towards Paris. According to orthodox theory, the circumstances surrounding Operation Goodwood favored the offensive, which means that this should have been an overwhelming British success. What ended up happening was that the British, employing a traditional strategy, were defeated by the modern-system-employing Germans. Biddle also includes the case of Operation Desert Storm in the First Gulf War. While this is not a critical case (the Americans enjoyed superiority in both capabilities and force employment), Biddle uses it to support his theory by focusing on how and why the Coalition was able to break through Iraqi defenses with such a low loss rate (according to Biddle, this was because of their force employment).

Biddle's (2004) next stage of testing his theory is through statistical analysis. As stated before, the largest problem in conducting this analysis is the lack of direct measures of force employment in the standard political science datasets. Biddle gets around this problem by using indirect statistical tests. He derives hypotheses by deducing the effects of force employment on other variables. Biddle predicts that the use of the modern system will have effects on observed variables that are the opposite of what the traditional capability theory would predict. This means that the predicted relationships between his key variables will be different than what the orthodox theory would predict. Thus, the two theories can be evaluated against each other using this indirect method. Biddle's dependent variables are loss-exchange ratios (attacker casualties: defender

casualties), territorial gain, and combat duration. His main independent variables are force-to-force ratios, force-to-space ratios, systematic technological sophistication (referring to the advances in military technology in the system as a whole), and the dyadic technological imbalance (expected to reflect one side having better military technology than the other). Using these variables, Biddle derives, and tests, a variety of hypotheses. For example, he states that the traditional theory predicts that the loss-exchange ratio (LER, attacker casualties per defender casualties) will be inversely proportional to the force-to-force ratio (FFR, the ratio of attacker forces to defender forces). Biddle's theory predicts instead that the LER will increase with respect to the FFR, a hypothesis that is supported by the empirical tests. Across the various tests, the hypotheses derived from Biddle's (2004) are more strongly supported than those derived from the traditional capability-based theory.

Finally, Biddle (2004) uses computer simulation experimentation for one more test of his theory. The advantage that this method has over the other two is that it addresses the problem of selection on wars (as the cases can be generated with any chosen values for the key variables) and allows for the testing of predictions for which there are no cases (Biddle cites the example of modern, late 20th century weapons being used against an enemy that has fully embraced the modern system of warfighting). Biddle (2004) compares his theory to the orthodox theory by, in the simulation, manipulating both the strategies and the differential in the level of weapon technologies between both sides. Biddle finds support for his theory by showing that, like he would predict, the interaction between advanced weapons and the use of the modern system leads to a low loss-exchange ratio.

Classification of Military Strategy

If we are to use military strategy as an independent variable to study conflict outcomes, it is first important to determine how to classify the different forms of military strategies. The classification that is chosen is important because it can affect the entire approach of a study. For example, a classification that is based on the political aims of the attack (offense/defense, for example) will lead to a study that is best approached at the grand strategy level, whereas a classification that focuses on tactics and maneuvers (maneuver/attrition) may lend itself to an operational-level study that uses battles as its unit of analysis. In the section that follows I will review various well-known classifications that have been used in the political science literature.

The first classification of military strategies (or "doctrines," as Posen (1984) prefers to refer to them) that I will consider is that between offensive and defensive strategies (Posen 1984, Snyder 1984, Van Evera 1984). This classification of military strategies focuses on what the aims of a particular military operation are, and is often linked with the political strategy of a state. The main distinction is between offensive strategies, under which states seek to conquer other territories or somehow alter the status quo, and defensive strategies, in which a state seeks to maintain the status quo or deny another state its expansive objectives (Snyder 1984, Posen 1984).[7] The German use of blitzkrieg during the Second World War, as well as the strategy adopted by most participants of World War I, are suggested as examples of offensive strategies (Snyder

[7] Posen (1984) includes a third category, deterrent strategies. Deterrent strategies aim to punish an aggressor by raising its costs without raising one's own costs.

1984, Posen 1984). Posen (1984) suggests the French strategy during the Second World War (illustrated by the Maginot Line) as an example of a defensive strategy.

One of the better known classifications of military strategy is John Mearsheimer's (1983) differentiation between attrition and blitzkrieg strategies[8]. According to Mearsheimer's (1983) classification, an attrition strategy is one in which the aim is to destroy the enemy militarily. This is done through a series of direct confrontations during which the forces attempt to wear down the enemy until defense is no longer possible. Thus, the armed forces must rely on superior firepower in order to be able to outlast the enemy in battle. In an attrition form of fighting, the forces do not avoid the strong points of the enemy's defense. Rather, they confront them directly through a broad attack, penetrating the enemy's front line only shallowly (this is done so that the integrity of the attack can be maintained as the enemy is pushed back through a broad front) (Mearsheimer 1983).

Mearsheimer's (1983) second military strategy, the foil to attrition, is that of blitzkrieg. Its principal aim is strategic penetration, which should in turn lead to a decisive victory without having to fight the series of battles that one would have to under an attrition strategy. A blitzkrieg strategy does not attempt to confront the defenses directly. Rather, it targets the weak points in the enemy's front, aiming for a breakthrough and then deep penetration. Once the forces have penetrated the enemy's line, they must maintain their speed before the enemy's forces are able to regroup and move the front further back. This fast-moving, penetrating column aims to target the "nodal points" of the enemy that are situated deep inside its defenses. By "nodal points"

[8] Mearsheimer (1983) also has a third category, limited strategy, which can mainly be differentiated from the other two by its aims, rather than by the actual conduct of the fighting.

Mearsheimer (1983) is referring to the points at which communication, transportation, and supply lines intersect. Thus, even if the enemy is not completely defeated militarily, the isolated military units are incapacitated by the fact that they can no longer communicate or coordinate. Thus, these isolated forces may be defeated by an enemy that is actually weaker than the aggregate of them (Mearsheimer 1983). Though useful, Mearsheimer's categorization fails to account for more unconventional forms of fighting. For example, it is difficult to place guerrilla fighting under either category. The same problem arises when we try to categorize attacks on non-traditional targets, such as population centers or the economic infrastructure of the opponent.

Recently, one of the more prevalent classifications of military strategy that has been used in International Relations is that of attrition, maneuver and punishment (Reiter and Meek 1999, Stam 1996). This classification can be traced back to Mearsheimer's (1983) distinction between attrition and blitzkrieg, but also addresses some of its shortcomings. Those who use it cite as one of its advantages the fact that it is apolitical and separates military strategy from war aims, which is something that is not always the case when using the offense/defense categorization (Stam 1996, Reiter and Meek 1999). The military strategies of attrition, maneuver or punishment can be used by both the offense and the defense, and are close to how militaries themselves classify military strategies (Reiter and Meek 1999). It has also been cited as appropriate for studying 20th century conflict, as most of the military strategies used in that time period can be classified into one of the three categories (Reiter and Meek 1999).

An attrition strategy is generally defined as one in which firepower is emphasized over mobility. The forces employing an attrition strategy will attempt to destroy or

capture as many of the enemy's troops through a war of annihilation, focusing on inflicting high casualties (Reiter and Meek 1999). Its aim is to destroy or capture enough of the enemy's forces that they will be unable to continue fighting. In order to do this, large-scale confrontations are sought (Stam 1996).

A maneuver strategy is analogous to Mearsheimer's (1983) "blitzkrieg" strategy, but is somewhat broader. It is one that emphasizes mobility over firepower, focusing on the speed of the attack. Its main aim is to, through a narrow point of attack, create a breach in the enemy's line through which one's forces can be inserted behind enemy lines, thus disrupting communications, command and control. In order to be able to achieve this, highly mobile forces are needed (Reiter and Meek 1999). Maneuver strategies avoid large-scale battles in which the aim is the annihilation of the enemy. Rather, they focus on capturing territory, but not for its intrinsic value. Territory is useful only as a means to disrupt the operations of the enemy, as it allows one's troops to be inserted behind enemy lines. Maneuver is different from attrition in that it does not focus on destroying the enemy's troops, but rather on disrupting their organization enough to lead to a quick victory. In fact, the seeking of quick outcomes and few casualties are another characteristic of maneuver strategies (Stam 1996).

The third category, punishment, encompasses the widest range of strategies. It is different from both attrition and maneuver strategies in that it does not seek to defeat the enemy militarily. Rather, punishment strategies will seek to impose high-enough costs on the opponent that it will lose its will to fight, through the loss of morale or public or political support. In other words, punishment strategies seek to break the resolve of the opponent and force them to concessions even if they actually still have the capabilities to

continue fighting (Reiter and Meek 1999, Stam 1996). It relies on the opponent not being able to adapt to the costs that are being inflicted on it in a way that will allow it to maintain its political and public support (Stam 1996). This category can include strategies such as counter-civilian aerial bombardment and guerrilla warfare.

Another categorization of military strategies that has been used recently is Stephen Biddle's (2004) distinction between traditional warfare and what he calls the modern system of war-fighting. The modern system, as defined by Biddle (2004), relies on concealment, surprise, mobility and maneuver. To put it in Biddle's exact words, it is "a tightly interrelated complex of cover, concealment, dispersion, suppression, small-unit independent maneuver, and combined arms at the tactical level, and depth, reserves and differential concentration at the operational level of war" (Biddle 2004, 3). According to Biddle (2004), the effective use of the modern system can overcome even a technological or numerical disadvantage at war.

One aspect of modern operations is that they have limited aims and are not necessarily designed to break through themselves. Instead, they exploit temporary advantage conveyed by differential concentration to seize important terrain or major sections of the defender's prepared positions (Biddle, 2004). In other words, the modern system stresses creating temporary advantages that disrupt the system and allow forces to achieve a swift victory.

One element that Biddle emphasizes as modern is inducing the systemic collapse of a defense while fighting only a fraction of it directly. Destroying the support infrastructure (supply lines) and concentrating forces disproportionately at a given point

in order to deny the enemy the ability to move resources behind the front line is considered modern.

At first glance, we might think that the modern/non-modern distinction is the same as the maneuver/attrition distinction. A closer look, though, reveals some key differences between the two. One is that Biddle's (2004) non-modern category is not a perfect equivalent of attrition. In fact, it encompasses aspects of punishment, as punitive attacks fall under the category of non-modern. For example, counter-civilian aerial bombardment (considered punishment in the previous categorization) would not be considered modern, as its aim is not really to create a temporary advantage that can be exploited, but to apply pressure to the enemy by increasing costs.

A key aspect of the modern strategy is that its aim is to attack key decisive targets that will have repercussions on other aspects of the enemy's forces. While this is similar to maneuver's emphasis on mobility, speed and inserting forces behind enemy lines, it could also encompass certain forms of guerrilla warfare.

Mearsheimer (1983) also makes the point that his distinction between attrition and blitzkrieg (which is essentially maneuver) is specifically meant to apply to ground war. In particular, it's a distinction that applies only to the modern (post-WWI) battlefield in which the armored tank plays a key role. Thus, applying a classification which specifically refers to ground warfare may be problematic when dealing with air power. For example, one of the key characteristics of Mearsheimer's (1983) definition of blitzkrieg is that the penetrating column must move as fast as possible to get to the rear of the enemy's defenses. This point is irrelevant when dealing with air power, as any

aircraft could quickly reach the rear of the enemy's line. Thus, the question becomes not how fast to get there, but rather whether to get there and what targets to choose.

Table 2.1: Categorization of Strategies

Authors associated with the strategy	**Posen 1984, Snyder 1984, Van Evera 1984**	**Mearsheimer 1983**	**Stam 1996, Reiter & Meek**	**Biddle 2004**
Strategy 1	Offensive -Conquer other territories -Alter status quo	Attrition -Aims to destroy enemy militarily -Series of direct confrontations -Wear down enemy until defense no longer possible -Shallow penetration	Attrition -Firepower emphasized over mobility -Focus on inflicting high casualties -Destroy or capture enough of enemy's forces to keep them from fighting -Large-scale confrontations are sought out	Orthodox/Non-modern -Emphasis on destructive firepower -Destroy or capture enough of enemy's forces to keep them from fighting. -Includes punitive attacks -General aims
Strategy 2	Defensive -Deny another state its expansive objectives -Maintain status quo	Blitzkrieg -Aims for decisive victory without series of battles -Targets weak points in enemy's front. -Penetrating columns use speed to target "nodal points" -Strategic, deep penetration	Maneuver -Emphasize mobility over firepower. -Focus on the speed of the attack -Narrow point of attack, create breach in enemy's line, insert forces -Disrupt enemy's operations	Modern -Limited aims, not designed to break through themselves -Stresses temporary advantages -Disrupt system, swift victory
Strategy 3	---		Punishment -Does not seek to defeat enemy militarily -Impose high costs on enemy to make it lose will to fight -Break opponent's resolve -Includes counter-civilian bombing and guerrilla warfare.	

Notes	-Focus on aims of military operation -Linked with political strategy	-A blitzkrieg strategy may allow for the victory of the weaker side.	-Separates military strategy from war aims -Apolitical	-Key aspect of modern system is attacking targets that will have repercussions on other aspects of enemy's forces.

The Use of Air Power in Conflict

So far, much of the reviewed work focuses on strategy as it applies to ground power. As stated before, most of the definitions that are used to classify the different strategies are based off of the actions of ground troops. Also, most of these pieces do not actually address the point of whether the strategies on the ground are the same as those in the air. Recently, though, the scholarship has begun to focus on distinguishing between the different ways in which air power can be used.

Italian General Giulio Douhet's writings in 1922 were some of the first on the use of air power. Douhet was a strong advocate of air power, and particularly emphasized the importance of being able to hit targets (such as population centers) that were previously inaccessible without first defeating the enemy's defenses. Despite Douhet overestimating the vulnerability of targets to air power, he is considered a leading air theorist and his writing (for example, his emphasis on strategic bombing) has influenced the doctrines of many modern air forces, including the United States Air Force. Since, much has been written in the International Relations literature about how air power has changed the way in which war is fought. Air power, though perhaps not as much as Douhet would have predicted, exposes previously invulnerable targets (such as population centers or leadership headquarters) to enemy attacks (Douhet 1922). While

air defenses have certainly developed throughout the years, it is also true that it is no longer necessary to defeat the enemy's ground forces in order to reach its population centers, leadership, and industrial zones. The use of air power expands the range of targets, making these previously protected targets options for attack.

In the rationalist framework of war initiation and termination, air power can be viewed as an important tool that can be used to transmit information about a state's ability to impose its will on another and can also facilitate the achievement of absolute war outcomes (or at least can impose high-enough cost on the opponent to make it willing to accept a settlement and stop trying for an absolute victory). As stated before, the use of air power greatly widens the range of targets that are available to a state. This means that the choice of targets in air campaigns can also become a highly political process. While the tactics to be used in carrying out an aerial attack are usually decided by military leaders, the choice of what types of targets to hit is most often a careful and deliberate decision by a state's leadership, meant to signal the state's strength and the costs of continuing to fight (we can think of the bombing of Hiroshima and Nagasaki as an extreme example of this) and/or to cripple the opponent to the point where it is no longer able to fight (this appears to have been the aim in many of the early uses of air power by European powers against colonial rebels).

One of the more influential recent works on the use of air power in conflict has been John Warden's[9] (2000) The Air Campaign, originally published in 1988. His ideas have since continued to hold much weight in the doctrine of the USAF. Though not an empirical piece, Warden's work puts forward a theory on how to effectively execute an

[9] Under the George H.W. Bush administration, Warden was tasked with creating the plan for the air campaign that was used in the First Gulf War against Iraq.

air campaign at the operational level. Warden (2000) stresses the importance of air superiority, noting that in the history of modern warfare no country that had established air superiority has ever lost a war. Key to achieving air superiority, in Warden's view, is successfully identifying and targeting what he refers to as "centers of gravity." By "centers of gravity" Warden (2000) is referring to the points where the enemy is the most vulnerable, and therefore where an attack has the highest probability of being decisive.

The centers of gravity can include equipment (such as the actual aircraft), logistics (petroleum, spare parts, munitions), personnel (air crews, pilot training facilities) and the enemy's command and control (command posts, communications) (Warden 2000). Centers of gravity will not be the same across the range of potential rivals. Key to a center of gravity is the fact that it is a vulnerable point for the opponent, and therefore an attack on it will have the highest chance of being decisive. According to Warden (2000), the political and military objectives will establish the nature of the conflict, and once this is known the fastest and least costly way to win a war will be to identify and target these centers of gravity. Part of the challenge that states will face will lie in being able to correctly identify the center of gravity of an opponent. Centers of gravity have special meaning for the target in that they are highly dependent on them. This means that the states conducting the attack will often have to shift their doctrines, attacking not necessarily the targets that their doctrine dictates, but the ones that are of key importance to the opponent.

Given that one of the basic attributes of air power is the fact that it expands the range of targets available to the attacker, it is no surprise that one of the basic categorizations of the use of air power is based on its targets and their strategic

importance to the opponent. Robert Pape, in his 1996 book Bombing to Win, makes the point that it is difficult to categorize air power by its targets alone, as the same target may be considered both military and civilian. While Pape (1996) keeps the focus on the target, his categorization is not based on the target itself, but rather on the process through which the destruction of the particular target is expected to alter the behavior of the state being attacked.

Pape's (1996) first (out of four) category is punishment. The aim of a punishment air strategy is to inflict enough damage on a population (to raise its costs of continuing to fight enough) to convince them to capitulate. This may include the bombing of population centers and other targets that can damage the civilian economy. The logic behind this sort of attack (which is similar to Douhet's arguments) is that if enough harm is inflicted on the population, it will pressure its government to stop the war. An example that Pape (1996) gives of this sort of air strategy is the British bombing of Germany during World War II, following the ideas of Hugh Trenchard, the British Marshal who is considered to be the father of the Royal Air Force, as well as one of the early advocates of strategic bombing.

The second category, risk, is similar to the punishment strategy, but rather than expecting the enemy to capitulate because of costs incurred, it aims to force the enemy to capitulate through the threat of future costs (this is a case in which states would be expecting the information dynamics to dominate in the resolution of conflict). Similarly to Schelling's (1966), the logic behind this sort of attack is to gradually increase the risk of civilian damage. Thus, the enemy capitulates to avoid suffering future costs. Similarly to the punishment strategy, this strategy focuses on population and economic

targets. Pape (1996) gives the US bombing of North Vietnam as an example of a risk air strategy.

The third category, denial, seeks capitulation through the weakening of the enemy forces to the point where they are no longer able to take or hold territory (this strategy is somewhat reminiscent of Reiter's (2009) argument that defeating the opponent to the point where it can no longer fight back will lead to the conclusion of a war). This strategy is based on destroying the actual armed forces or the arms manufacturing capability of the enemy. Thus, both interdiction[10] and close air support[11] would fall under the category of denial. Some forms of air-to-air combat may also fall under this category, as air to air combat is one way of destroying the actual armed forces of the enemy. According to Pape (1996), all major combatants in World War I used denial strategies, and this type of strategy is more likely to succeed against conventional forces, rather than guerrilla forces.

Finally, decapitation strategies focus on destabilizing the enemy by disabling its leadership. As advocated by Warden (2000) decapitation strategies target key leadership and telecommunications facilities. An example suggested by Pape (1996) is the precision-guided munitions used in Iraq during the First Gulf War that attacked Saddam Hussein's palaces and command centers. Another example would be the U.S. attempts at

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[10] Air interdiction refers to air operations conducted to divert (divert enemy forces from the places where they are most needed, or to more vulnerable areas), disrupt (disrupt command and control, intelligence, transportation, supply lines and psychological will), delay (delay to gain time for friendly forces, to pressure the opponent to attempt urgent movement, or to maintain the initiative), or destroy (destroy enemy forces and supplies, or create the perception of imminent destruction) the enemy's military potential before it can be brought to bear effectively against friendly forces, or to otherwise achieve objectives (Air Force Basic Doctrine 2003).

[11] To define close air support I use the Department of Defense Dictionary's definition: Air action by fixed and rotary-wing aircraft against hostile targets that are in close proximity to friendly forces and that require detailed integration of each air mission with the fire and movement of those forces. The proximity of close air support to friendly forces is not defined by actual distances, but rather by a "range within which some form of terminal attack control is required for fratricide prevention" (Counterland Operations 2006).

the beginning of the 2003 Iraq War to kill Saddam Hussein through targeted air strikes. In this case a statement by the Pentagon explicitly referred to the attack as a "decapitation attempt." This was done before the actual invasion of Iraq, with hopes of destabilizing the regime by killing Saddam and his top officials (Borger and Meek 2003).

Pape (1996), in his empirical analysis and case studies, focuses only on denial and punishment strategies. This is because he views risk strategies as being very similar to punishment strategies, with the main difference between them being only the rate at which targets are bombed. Both punishment and risk strategies aim for population and economic targets, with the difference being that risk strategies start bombing them at a slower rate, with the aim of coercing the opponent through the threat of further attacks in the future. Also, Pape (1996) argues that decapitation strategies will not be effective, as states' militaries can continue to fight even if the state's leader is killed or incapacitated. Further works that use Pape's (1996) categorization have also focused on denial and punishment (Horowitz and Reiter 2001, Allen 2007, Allen 2009).

Having settled on denial and punishment as the two major classifications of air power usage, Pape (1996) studies the use of air power in the context of coercion. In other words, he asks how air power can "change the behavior of a state by manipulating costs and benefits" (Pape 1996, 4). Pape (1996) defines successful coercion as changing the behavior of states that are still militarily capable of fighting. This essentially means that cases in which the opponent's behavior was changed after a complete military victory would not count as successful coercion, as it was necessary to completely incapacitate the opponent (and incur the costs of doing so) in order to alter its behavior. Cases in which coercive actions are stopped before the opponent makes any concessions, or cases in

which attacks on the opponent continue without it making concessions also count as coercive failures (Pape 1996).

Pape (1996) hypothesizes that denial will lead to more successful coercion than all of the other military strategies. In the empirical portion of his book, he uses all cases of uses of strategic air power in war from 1917 to 1991. Pape (1996) focuses exclusively on strategic uses of air power because he finds that strategic air power can involve both denial and punishment strategies, whereas interdiction and close air support involved exclusively denial. Because Pape (1996) has no direct measures of the use of air power as denial or punishment, he tests his hypotheses indirectly. His main independent variables are civilian and military vulnerability (coded as nil, low, medium, high and very high). The logic behind this measure is that civilian vulnerability will mean that a punishment strategy will be used, whereas military vulnerability means that a denial strategy will be used. Using this measure, Pape (1996) finds support for his hypothesis that denial strategies lead to more effective coercion than do punishment strategies.

Following Pape (1996), various other studies have evaluated the coercive success of air power strategies, often finding support for his finding that denial strategies are more successful for coercion than are punishment strategies (Horowitz & Reiter 2001, to cite one example). More recent studies have also included a variety of independent variables that are expected to also affect the effectiveness of coercive uses of air power. Horowitz and Reiter (2001), expanding Pape's (1996) dataset to include cases of strategic bombing through 1999 and using a probit regression analysis (but keeping Pape's coding of civilian and military vulnerability as the measure of strategy) find that the coercive

success of air power is diminished if the attacking country is making a demand for regime change.

While Horowitz and Reiter (2001) find no support for their hypotheses about the effect of regime type on the effectiveness of coercive aerial bombing, Allen (2007), finds that when the dependent variable is switched to include not only the effectiveness of bombing campaigns, but also their duration, regime type can indeed have an influence on coercive success. Further expanding Horowitz and Reiter's (2001) data to 2003 and using duration analysis to estimate the length of bombing campaigns, Allen (2007) finds that democratic attackers concede more quickly (ending bombing campaigns) than do autocratic attackers. This is the case even when this concession means accepting failure, as democratic leaders fear long conflicts in which they may lose the support of their publics (Allen 2007, Bennett and Stam 1998). Allen (2007) finds even stronger support for her hypothesis that bombing campaigns against democratic targets are also shorter, ending with the attacker conceding. The reason behind this is that democracies are able to send stronger signals of resolve, as they are able to convey more credible information than autocracies (Schultz 1998, Allen 2007). Thus, a democracy that holds out during a bombing campaign against it is sending a stronger signal of resolve than would an autocracy in a similar position, leading its adversary to concede sooner (Allen 2007).

Following on this same theoretical approach, Allen and Vincent (2011), suggest that aerial bombing may serve not only as a coercive tool, but also as a mechanism to provide information about the intentions and resolve of the attacker. Taking a war-as-bargaining approach, Allen and Vincent (2011) suggest air strikes are a source of information during war. Thus, not only will we expect that more sorties and more attacks

on military targets (Pape's approach) should lead to an increased chance of conciliation, but also that as time passes (and air strikes continue, thus providing more information), conciliation should become more likely. Using the particular case of the air war in Kosovo (with each day of the campaign counting as a separate observation), Allen and Vincent (2011) measure the effect of their independent variables on the official statements made from Belgrade (which are coded as either defiant or conciliatory in tone). Allen and Vincent (2011) find no support for the hypothesis (in line with Pape (1996)) that bombing military targets is more likely to lead to conciliatory statements. Rather, they find support for their bombing-as-information hypotheses, finding that as days pass (in which bombing continues), the Belgrade government is more likely to make concessions).

A more recent paper by Allen (2009)[12], introduces a new dataset that addresses some of the shortcomings of Pape's (1996) previous data and analysis. One of the potential weaknesses of Pape's dataset is the fact that its main independent variable (the type of aerial strategy being used) remains an indirect measure. Allen, in the new dataset, recodes the different strategies that were used, including a new category that allows for mixed strategy. This new coding is based off of the statements made by state leaders on the aims of a particular bombing campaign. As Allen (2009) herself notes, this new coding does not always match up with Pape's (1996) coding of the different strategies used[13].

[12] The date "2009" refers the date on a working version of this paper, which is at the time unpublished.
[13] This difference stems from the fact that Pape (1996) coded strategies based on the vulnerability of states to different targets, whereas Allen (2009) uses statements made by leaders, either from primary and secondary sources. In her paper, Allen (2009) includes a correlation matrix in which her denial strategy variable and Pape's denial vulnerability variable have a correlation coefficient of -0.100. Her punishment strategy variable and Pape's punishment vulnerability have a correlation coefficient of .218.

Besides coding the aim of each campaign as denial or punishment (or both), Allen (2009), also includes variables that capture the means through which coercion is attempted. These variables include breaking civilian morale, damaging the homeland economy of the target state, interdiction, decapitation, and targeting fielded forces. This variable gives a clearer impression of how strategic bombing is expected by the attacker to lead to coercion. Allen's (2009) analysis also includes measures of regime type, of the use of guerrilla warfare (by the target state), of the demands being made (similarly to Horowitz and Reiter (2001)), and of the military strength of the attacker state.

In this new dataset Allen (2009) also makes some changes to Pape's (1996) dependent variable that aims to measure the effectiveness of coercion. In her new dataset, Allen (2009) identifies the political and military goals of the attacker and whether they were met. The variable is then coded zero if neither goals was met, one if one of the two was met, and two if both the military and political goals of the attacking state were met through coercion. In this new analysis, decapitation and attacks on civilian morale are found to be negatively correlated with successful coercion, as are guerrilla tactics used by the target state (Allen 2009).

This finding by Allen (2009) suggests that it may be important, not only when studying air power but when studying military strategies in general, to consider also focusing on the target's actions. Stam (1996) states that the best choice of military strategy depends on what strategy the opponent is using, with some strategies being more effective against other particular strategies. Thus, it appears to be the case that the natural progression in the study of air power is to take into account what the opponent is doing.

This is true as far as the opponent's air strategy goes, but also as far as what is happening on the ground. Reiter and Horowitz (2001) find that troops on the ground make coercive bombing more effective, but this may depend on what exactly those troops on the ground are doing, as well as on the strategy of the enemy's troops on the ground. This means that while the body of work on air power may provide us with an advance in our understanding of the uses of strategy in war, we still need to be able to distinguish between strategies on the ground and in the air, and understand how they can interact to affect conflict outcomes. This inter-level comparison (between air and ground power) will require a categorization of strategy that can be applied to both ground and air actions. This means that we will have to move away from the denial/punishment categorization and also include non-strategic uses of air power that will be analogous to ground actions.

Conclusion

This chapter began with a discussion of the rationalist explanations for war initiation and termination, under a bargaining framework. As wars begin because of asymmetric information and commitment problems, they will thus end when enough information is shared to agree on a settlement or when the commitment problems have been resolved (J. Fearon 1995, Reiter 2009). If we believe this to be true, then it is important to also understand the process through which information can be shared in conflict or the commitment problems resolved. In one way or another, we can say that many of the works that study the effect of different variables on war outcomes are attempting to do just this. In this dissertation I will focus on military strategies, specifically aerial strategies, because military strategies are particular in the sense that

they can lead to mutual optimism between two different states as they go into war, and only by actually testing the military strategies in the field will states be able to resolve their different prior beliefs as to their own superiority (Smith and Stam 2004). Air power strategies in particular, besides being understudied relative to ground strategies, provide states with the opportunity to effectively provide information about the potential costs of continuing to fight. The choice of aerial strategies is also a strongly political one that can be part not only of a state's military strategy, but also of its political and diplomatic strategy. Previous classifications of military strategy have mostly distinguished only between military and civilian targets, and have tended to discuss air power in isolation. This dissertation will attempt to fill this void by providing a new classification of aerial strategies and discussing their interaction with ground strategies, both those of the attacker and the target state.

CHAPTER 3: THEORY

Air Power and Understanding Conflict Outcomes

Geoffrey Blainey, writing in 1973, argued that in order to understand why wars begin, one must understand why they ended. This implies that if we want to truly understand wars as a phenomenon, we must also widen our understanding of conflict outcomes. Conflict outcomes in international relations have often been treated as a costly lottery. As Wagner (2000) argues, the problem with this approach is that we often have no realistic basis to determine what the expectations of such a lottery would be. As most wars are not fought to the finish, but rather terminated through some negotiated settlement, using capabilities to determine the outcome of such a lottery may be inaccurate (Wagner 2000).

If we cannot predict conflict outcomes basing ourselves solely on capabilities, we must think about other aspects that may determine the outcome of a conflict. Blainey (1973) argued that wars start because of mutual optimism. More recently, Wagner's (2000) model shows two states with roughly equal material capabilities going to war against each other because one of them is confident that it has an advantage due to the superior training and intelligence of its military. Similarly, Slantchev (2003) and Smith and Stam (2004) highlight how actual battlefield behavior can provide information beyond what can be shared in negotiations. All of these different works seem to point to the conclusion that the way in which a war is fought, beyond the capabilities of the involved parties, can affect its outcome.

If we stop and think about how states can win or lose military campaigns, it can be boiled down to stating that states succeed in military campaigns when they are able to

impose costs on their opponent while minimizing the costs that are imposed on them. A military campaign is won when states are able to effectively convince the opponent (by imposing costs or threatening to impose further costs), that it is preferable to make concessions rather than to continue fighting. Military strategy, the way in which military forces are used to achieve a particular objective, is one way in which states can affect the outcome of a conflict. Choosing the "right" military strategy for a given conflict can allow a state to impose high costs on its opponent, while shielding itself from costs. Going into a conflict, states will have a given set of material capabilities. Much of the uncertainty of the outcome, though, will depend on *how* those capabilities are used. Thus, understanding military strategy and how it can help states to achieve both their military and political outcomes will allow us to better understand conflict outcomes.

In particular, I will focus on strategy in the air. Often, when we study conflict outcomes in political science, the question arises as to whether this really is a political matter, as we can easily cross into the realm of military strategizing when dealing with states' behavior during war. The key to maintaining our work in the realm of political science is to focus not on the military tactics themselves, but in the variables that can affect whether a state is able to get the outcome it wants from a war. Aerial bombing, as I mentioned earlier, is a variable that affects conflict outcomes and has strong political motivations and implications that go beyond the military realm. The types of targets that are chosen, or even whether aerial bombing is used at all can strongly affect the willingness of the opponent to continue fighting, and thus the likelihood of the state that is doing the bombing getting its preferred outcome from the conflict. Beyond being a military tactic, aerial bombing is a foreign policy choice that states make when

attempting to achieve their aims in the international system. It can also be argued that the general strategy of aerial bombing, in particular the choice of targets, often comes more from political rather than military leadership. Aerial bombing becomes especially political in the sense that it is often thought of by both leaders and populations as a less "messy" way to fight. Particularly in Western states, the perception has been that avoiding ground combat will make for a "cleaner" war that is less likely to harm the political fate of the leaders.

In this chapter I will develop the theory that will guide the analysis in the chapters that are to follow. I will begin by discussing what coercion means for the sake of this dissertation, as well as why battlefield success can be operationalized as coercion. As coercion depends largely on convincing an adversary that continuing to fight will be costly, I will then discuss how states can use non-capability elements (such as military strategies) to persuade the adversary to stop fighting, without necessarily having to destroy the enemy's forces to the point where it can no longer keep fighting. Having done this, I will discuss the choice of classification for military strategy in the air (the modern vs. the non-modern system of strategy). I will then develop a theoretical model to explain how states choose their military strategies, and how using the modern system in the air may lead to coercion being successful or not.

Success and Coercion in Conflict

As stated before, the main dependent variable that I will be studying in this dissertation will be success in conflict. Though my first analytical chapter will focus on the choice of military strategy and the second one on the duration of aerial campaigns, the

ultimate goal of the project as a whole is to understand how different aerial strategies can affect the outcome of aerial campaigns (which by extension should affect the outcome of a conflict).

When I talk about successful outcomes I am referring to whether the state was able to achieve its political and military goals in conflict. If we think purely about military success, then the question becomes a military, not political one. While I will be considering whether states achieve military success as part of the measure of success in conflict, military success is not an end in itself. Rather, military success is a tool that is used by the states in question to achieve the political goal of making the opponent change its behavior. Thus, military victories serve as a tool to allow a state to achieve its political goals. They either transmit information about how much the attacker can harm its opponent (causing it to be more willing to agree to a settlement) or inflict enough harm on the opponent to keep it from being able to fight back when the attacker attempts to impose its will on it.

When we think of war, we can classify it as either total war or limited war. A total (absolute) war is one in which the aim is to destroy the opponent to the point where it is no longer able to fight back, and in which there is little or no limit in what can be considered an acceptable target. A limited (real) war, in contrast, is one in which the aim is not necessarily to make the enemy unable to fight, but to achieve some concessions from it, often by using only limited forces or a restricted range of targets (von Clausewitz 1976). Though there have been in history a few examples of wars that can be considered total war (An often-used example of total war is the Athenian campaign against the island of Melos in the Peloponnesian War, in which after Melos was defeated the Athenians

killed all adult men and sold all women and children into slavery, repopulating the island with Athenian colonists (Thucydides, History of the Peloponnesian War Ch 17)), it is generally the case that most conflicts are not fought until the opponent is completely unable to fight, but rather until it becomes too costly to do so and they then choose to capitulate. This means that, while the dependent variable of interest for this dissertation is success in military campaigns, from a practical point of view we can think of it as coercive success. Coercion is different from brute force in that it aims to change the behavior of a target without necessarily having to destroy it or its capability to keep fighting. Rather, the threat of incurring costs should cause the target to change its actions (Horowitz and Reiter 2001, Schelling 1966).

When we speak of coercion, its success can depend largely on convincing the enemy that the costs of continuing to fight are greater than the benefits involved. In other words, it involves the use of a threat that will be carried out if the adversary resists (Byman, Waxman and Larson 1999). Military strategy can be used as a tool to alter the other side's perception of conflict outcomes. It can be a form of persuading the adversary that it is likely to face defeat by continuing to fight, without necessarily having to destroy the enemy's forces.

Categorization of Strategies

In studying air power in relation to ground power, the choice of how to categorize it will be an important one, as it will have an effect on the research design of this dissertation. In chapter 2 I have reviewed a variety of different classifications of military strategy, and discussed why a most of them would be inappropriate for the study of air power strategies. In particular, the most commonly used categorization in current work

on military strategy, that of maneuver, attrition and punishment strategies (Stam 1996, Reiter and Meek 1999) will not be appropriate for this study. This is because this categorization is in large part based on the work of Mearsheimer (1983), which distinguishes between attrition and blitzkrieg (which is analogous to maneuver) warfare. Mearsheimer (1983) makes the point that this categorization is meant to apply specifically to ground (in particular, mechanized tank) warfare. Thus, it would be inappropriate to categorize air strategies using a scheme that is meant to apply only to ground warfare. Stephen Biddle's (2004) modern/non-modern categorization does not explicitly refer only to ground strategies and instead focuses more broadly on the type of targets chosen and on how those objectives are achieved. Thus, I find it to be more appropriate for studying air power and its relationship to ground strategies.

The Modern System

The modern system of war-fighting that I am referring to is that defined by Stephen Biddle in his 2004 book *Military Power*. I use Biddle's (2004)definition of modern warfare, which is as follows, "a tightly interrelated complex of cover, concealment, dispersion, suppression, small-unit independent maneuver, and combined arms at the tactical level, and depth, reserves, and differential concentration at the operational level of war."

According to Biddle (2004), the modern system emerged in the early twentieth century as a response to increased firepower that came about as a consequence of industrialization. As militaries were suddenly faced with the prospect of radical

firepower[14], they had to develop new military doctrines in order to be able to conduct "meaningful military operations" (S. Biddle 2004, 30). The answer first appeared to be entrenchment, as it seemed that forces in trenches would be much less vulnerable to this increased firepower. Mutually entrenched forces would naturally lead to a stalemate, and the new technology of the tank was seen as a way to break that stalemate. In the end, entrenched forces were not as safe from firepower as it had been thought, and the tank was neither "necessary not sufficient to break through entrenched defenses" (S. Biddle 2004, 30). States soon found that the best way to overcome the barrage of firepower was through force employment.

No single part of the "modern" system was necessarily new, but it was rather the combination of tactics and operations that was adapted to overcome new challenges. In fact, the modern system incorporated the pre-WWI emphasis on infantry with the early war emphasis on artillery to create a combined arms approach that allowed for cooperation between the two. At the tactical level the modern system emphasizes cover, concealment, dispersion, small-unit independent maneuver, suppression and combined arms integration. As stated before, though, this dissertation will focus on the operational level of war, and thus I will emphasize the definition of the modern system at that level.

Modern-system offensive operations emphasize breakthrough and exploitation of the enemy's defenses. The aim of breakthrough and exploitation is to "induce systemic collapse of a defense while fighting through only a fraction of it directly" (S. Biddle 2004, 40). This is done by targeting the supply lines and communications of the opposing side. Armies rely heavily on their established corridors that not only provide

[14] Biddle illustrates the change by discussing how during the Napoleonic wars an infantry battalion of 1,000 soldiers could expect to absorb approximately 2 shots per soldier before reaching a target 100 yards away. By 1916, that number had increased to 200 shots per soldier.

them with food, supplies, armaments, reserves, but also keep the in communication with command and control and with other forces. This infrastructure is usually set up in the rear of the defenses, where it can be protected by the troops from potential attackers. The modern system aims to gain access to this infrastructure and attack it directly, hoping to disturb the operations of the opponent enough to weaken them through the collapse of their organization (and thus be able to defeat them without necessarily having to overwhelm them in force) (S. Biddle 2004).

Access to the rear, under the modern system, is obtained through force concentration at a particular point in the enemy's defenses. This means that a greater advantage (a "local preponderance") will be had at that particular point, though the tradeoff will be that troops will be at a much larger disadvantage at other points in the front line. If performing effectively, these troops will be able to puncture the opponent's defenses by overwhelming them at a particular point and then advance deeper into the enemy's defenses. Once inside, they can engage in "deep battle," targeting the support and communications infrastructure of the opponent, limiting their effectiveness and hoping for an early collapse of the system.

The modern system emphasizes having limited aims. This means that forces will aim to exploit the temporary advantage given to them by force concentrations and seize strategically important positions that can then be used in offensives designed to bring about the collapse of the enemy before they can recover from the original attack. Force concentrations are able to only gain a temporary advantage. Soon enough reserves will be moved to that point, which will neutralize the advantage (and possibly even lead to a disadvantage) gained by attacking forces. Modern-system attackers are in a race against

reserves, seeking to terminate their attacks early before the opponents have an opportunity to regroup (S. Biddle 2004).

Modern-style defensive operations are designed to counter modern-style attacks. Static defenses are very vulnerable to modern attacks. In order to effectively counter modern attacks, defenses must be fluid and able to adapt. In particular, they need to be able to buy themselves time in order to respond to differential force concentration and be able to move their reserves to the point that is being attacked. The answer to this problem is to have greater depth in the defenses. The more a modern-style attacker progresses into the rear of the opponent, the more vulnerable and less coordinated it becomes, and thus less able to effectively execute the complex modern-system operations. Thus, a modern-system defense will be flexible and may even concede some initial territory to the advancing attackers before counterattacking them deeper into the rear, once they have lost some of their coordination.

Basing itself on Biddle's (2004) definition and John Warden's (2000)*The Air Campaign*, the aim of this dissertation will be to produce a definition of modern air power. The first step in this process will be to distinguish between different uses of air power. Having done this, it will then determine how each type of use can be modern or not.

Strategic Attack

Strategic attack can be defined using the United States Air Force's Basic Doctrine, which states that strategic attack is "offensive action conducted by command authorities aimed at generating effects that most directly achieve […] national security

objectives by affecting the adversary's leadership, conflict-sustaining resources, and strategy" (200340). We can also refer to the US Strategic Bombing Survey, which states that ""strategic bombing […] is aimed at the systematic destruction of those resources which will most weaken the enemy by denying him the materials or weapons he needs to prosecute the war" (US Strategic Bombing Survey, Jan 1947, p.2, pt. 2). Essentially, what strategic attack attempts to do is target the enemy's sources of strength without first having to engage their military forces (200340). Strategic attack seeks to strike directly at the centers of gravity (economic, military and diplomatic) of the enemy, thus denying it the resources to sustain its forces in the field. The USAF Basic Doctrine best sums up strategic attack in noting that it is about attacking the enemy as a system, not just on the field.

Interdiction

Air interdiction refers to air operations conducted to divert (divert enemy forces from the places where they are most needed, or to more vulnerable areas), disrupt (disrupt command and control, intelligence, transportation, supply lines and psychological will), delay (delay to gain time for friendly forces, to pressure the opponent to attempt urgent movement, or to maintain the initiative), or destroy (destroy enemy forces and supplies, or create the perception of imminent destruction) the enemy's military potential before it can be brought to bear effectively against friendly forces, or to otherwise achieve objectives (Air Force Basic Doctrine 2003). The USAF Basic Doctrine also adds that interdiction is directed against targets that are contributing to reinforcing the land battle. It aims to cut off ground forces from command and supply lines in order to make them

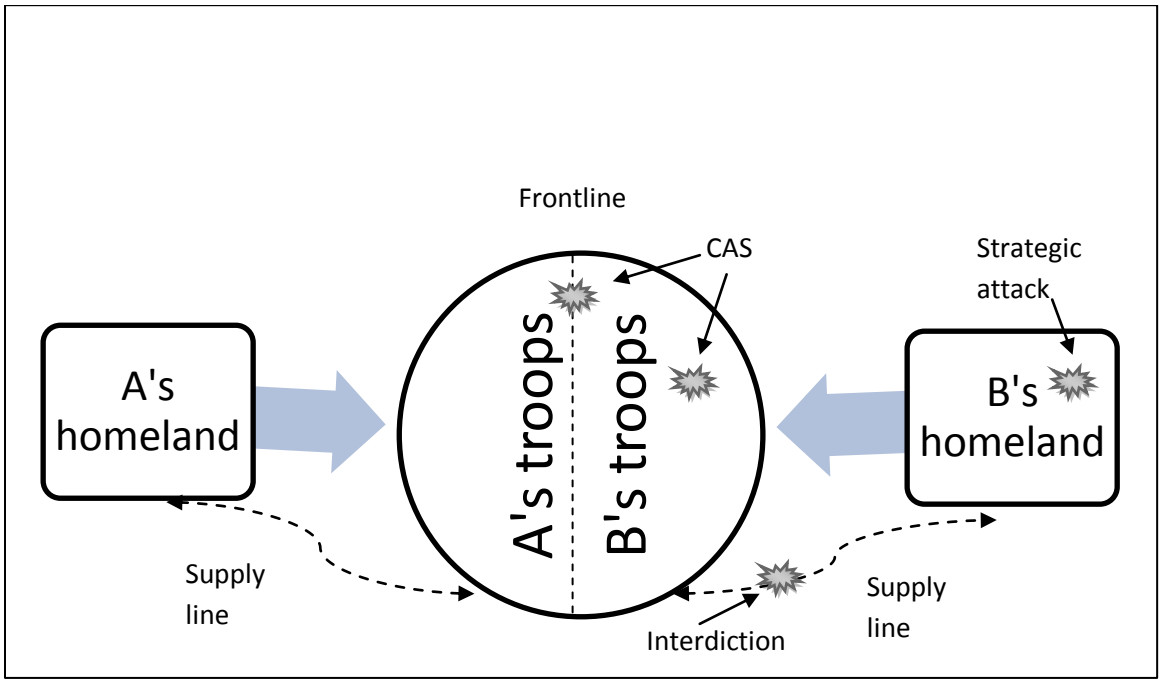
more vulnerable to attack. Air interdiction is conducted at such distances from friendly forces that detailed integration of each air mission with the fire and movement of friendly forces is not required. Part of its aim is to create opportunities for friendly commanders to exploit (20066).

Close Air Support (CAS)

To define close air support we can use the Department of Defense Dictionary's definition:" Air action by fixed and rotary-wing aircraft against hostile targets that are in close proximity to friendly forces and that require detailed integration of each air mission with the fire and movement of those forces". The proximity of close air support to friendly forces is not defined by actual distances, but rather by a "range within which some form of terminal attack control is required for fratricide prevention" (Counterland Operations 2006). The USAF Basic Doctrine states that CAS provides direct support to friendly forces that are already in contact with enemy forces, and aids them in achieving their objectives. Close air support can be used in preparation for battle or as reinforcement of attacks on the ground. Some examples of the use of CAS can include halting attacks, covering forces in retreat and guarding flanks (200345).

The following simplified diagram can be used make the difference between these three different uses of air power clearer.

Figure 3.1: The Uses of Air Power



In this diagram there are two generic states, A and B, which are facing off against each other in a conflict. There is a frontline where armed engagements take place, in between the fielded troops of both states. Beyond the battlefield there are the homelands of both states, which would include population centers and the general infrastructure of the state. We assume that there is an established supply line (there could of course be many; the diagram includes only one for simplicity's sake) that takes supplies to the battlefields from the homeland and maintains communication to and from the battlefield (we can imagine that this is where troops would also be transported along when switched out with reserves). In the diagram we can see (in an extremely simplified manner), that attacks along the frontline, or of the enemy's troops that are close to friendly troops can be considered close air support. Attacks deeper into the homeland can be considered

strategic attacks. Finally, attacks along the supply line fall under the category of interdiction.

Modern Air Power

At this point I will apply Biddle's definition of modern war-fighting to air power, and determine how each one of the different uses of air power could be categorized as modern. When categorizing uses of air power as modern, I will refer to cases that can be analogous to Biddle's (2004) definition of the modern system of warfare.

Biddle does not use the term "modern" to refer to campaigns that happened after a particular period in time, but rather a type of fighting which can be observed at different periods in time. At the same time, it is important to also keep in mind that the modern system is not completely unrelated to time. As technology increases, engaging in precision bombing becomes much easier. In older wars it may have been the case that stands had the intention of engaging in precision bombing that was consistent with the modern system, but their lack of technology made the campaigns virtually indistinguishable from non-modern ones. The same idea applies to states with less resources available to them. It may be the case that they are not able to engage in the modern system to the extent to which they would desire, because they have old, outdate equipment that does not allow them to work with the precision required for an effective modern campaign. This means that in conducting the analysis it will be important to consider temporal effects, as well as the capabilities of states involved.

Modern Strategic Attack

One aspect of modern operations is that they have limited aims and are not necessarily designed to break through themselves. Instead, they exploit temporary advantage conveyed by differential concentration to seize important terrain or major sections of the defender's prepared positions (S. Biddle 2004). When dealing with the use of air power, we can consider strategic bombing intended to harm the enemy's economic ability to wage war as a way to create this type of temporary advantage (since it takes time to get factories and plant back in working conditions after they have been targeted) and put the enemy in a more vulnerable position. What we must also consider when determining that a particular use of strategic air attack is modern, is that it not cause a large amount of indirect collateral damage, and that it not have a long-term impact on the civilian economy of the target country, as this would make the attack punitive in nature and thus non-modern. For example, during the 1991 Gulf War, U.S. attacks on Iraq's electrical system were considered to be strategic attacks on military targets (Warden 2000). What makes these attacks non-modern, though, was the indirect collateral damage caused by them. Repair of electrical facilities took longer than expected, meaning that a large number of civilians were harmed by the attack, and there was long-term damage to Iraq's infrastructure.

There is a very large variety of targets that can be the focus of strategic bombing campaigns. For example, during World War II the United States targeted German aircraft plants. This sort of attack, which destroys military materiel at the source and impairs the enemy's ability to engage in battle, would certainly fall under the category of modern. Another target of the United States were German oil plants. The extensive

bombing of oil plants, intended to deny Germany aviation and tank fuel also had effects on non-military aspects of German production. For example, the attacks on the German synthetic oil plants also cut down the production of nitrogen, which was heavily used in German agriculture (USSBS). One could see how an attack on such a non-specific resource such as oil could have negative effects in non-military life, and thus could be considered punitive in nature. When classifying strategic bombing as modern or not, we have to think about whether the attacks are intended to impair the target's ability to wage war (but allow it to continue non-military production without much disturbance), which would make the attack modern, as it would allow the attacker to exploit this window of opportunity in which they have a temporary advantage over the opponent. The other possibility would be that the strategic bombing is meant to impair entire sectors of the economy that do not relate exclusively to military production.

Non-Modern Strategic Attack

One way in which strategic attack can be modern is by creating temporary advantages that disrupt the system and allow forces to achieve a swift victory. Strategic bombing that is punitive in character (for example, targeting civilians or non-industrial areas), does not create this type of advantage and would therefore not be considered modern.

When considering strategic bombing and whether it is a modern use of air power, we also have to consider that without the proper technology, the outcome of a selective bombing campaign may end up looking the same as one of a punitive nature. In this case, a decision must be made as to whether we would categorize such a campaign based

on intent or on the outcome. This decision would largely depend on the theoretical framework in which the concept of modern air power was used. In the case of this particular project, which is seeking to evaluate the effectiveness of a modern style of air warfare, I would suggest coding according to outcomes. After all, it is outcomes, and not intent, that are observed both by the target state and by third party. Also, states may have an incentive to misrepresent their intent and claim that a particular bombing campaign was meant to be selective, even when it was not.

Of course, often the intention of strategic bombing is to conduct area, as opposed to precision, bombing. The use of strategic bombing by Sir Arthur "Bomber" Harris of the RAF during WWII is one example of strategic attack that emphasized area bombing over precision. Harris wrote in February 1945 "I do not personally regard the whole of the remaining cities of Germany as worth the bones of one British Grenadier" (Cross 1995) and that "the aim of the Combined Bomber Offensive should be unambiguously stated [as] the destruction of German cities, the killing of German workers, and the disruption of civilized life throughout Germany" (Denson 1999). He also illustrated how all targeting of non-military resources can be considered part of strategic attack, when he stated "it should be emphasized that the destruction of houses, public utilities, transport and lives, the creation of a refugee problem on an unprecedented scale, and the breakdown of morale both at home and at the battle fronts by fear of extended and intensified bombing, are accepted and intended aims of our bombing policy. They are not by-products of attempts to hit factories" (Sokolski 2004).

Modern Interdiction

One element that Biddle emphasizes as modern is inducing the systemic collapse of a defense while fighting only a fraction of it directly. Destroying the support infrastructure (supply lines) and concentrating forces disproportionately at a given point in order to deny the enemy the ability to move resources behind the front line is considered modern. The equivalent use of air power would be interdiction in which air operations are conducted to divert, disrupt, delay, or destroy the enemy's military potential before it can be brought to bear effectively against friendly forces or otherwise achieve objectives (Warden 2000). This also includes cases in which the targets are lines of communication whose destruction would impede the movement of the enemy's forces (for example, bridges or highways that the enemy needs to cross in order to conduct an attack) (Warden 2000). Many of the advantages created by air interdiction are temporary windows of opportunity that must be taken advantage of by ground forces, which seems to fit with the modern style of war-fighting. The Air Force doctrine document on counterland operations states how air interdiction can create "artificial or temporary chokepoints by laying large numbers of scatterable mines, dropping bridges, or collapsing tunnels" (200623). Thus, we can consider attacks on infrastructure of this sort to be in line with the modern system. The transportation system may also be targeted in interdiction. In this case we would classify as modern those attacks that targeted the aforementioned actual conduit for travel (roads, rail, etc.), energy required to operate vehicles, and the loading and unloading points in the transportation system (rail yards, harbors and airfields (Counterland Operations 2006). Also, I will classify as modern

those attacks against non-combat military units, such as headquarters, which are aimed at disturbing the command and control of enemy forces.

Non-Modern Interdiction

Though interdiction generally seems to fall under the category of modern war-fighting, not every single case of interdiction can be considered modern. One of the aims of interdiction can be the attrition of enemy forces and materiel. We can think specifically of cases in which the targets are military forces (such as the actual troops), which would not really fall into the category of targeting the lines of communication or transportation. Also, Warden (2000)categorizes as interdiction the use of air power to slow down an enemy that is pursuing forces in retreat. This case of interdiction would not fall into Biddle's definition of modern war-fighting, as it is not exploiting a window of opportunity or targeting resources. Instead it is directly targeting the actual military forces. When targeting the transportation system, we would classify as non-modern those attacks that targeted vehicles used to transport troops or supplies along the conduit (as these would be attacks on the actual military units). The Air Force doctrine document on counterland operations states that air interdiction against fielded forces is one of the more limited uses of air interdiction, "mainly due to the difficulty of finding and targeting individual guns or vehicles" (200625). We can see how air interdiction against the actual military units would require more assets and would therefore be less in line with the principles of modern war-fighting.

Modern Close Air Support (CAS)

At first glance, we might not think of close air support (CAS) as being modern, as it often involves the destruction of as large a number of military targets that are threatening friendly forces. A closer look, though, reveals differences within CAS. The US Air Force doctrine document on counterland operations states that to be most effective, CAS "should be used at decisive points in a battle and should normally be massed to apply concentrated combat power and saturate defenses" (20066). CAS should not always be thought of as a substitute for artillery. In fact, this previous document also stresses the importance of using CAS against targets that are beyond the range of troops in contact. CAS support can also be used in a modern fashion when its task is to provide selective and discriminating firepower (200634)

Non-Modern Close Air Support

One way in which close air support can be used in military conflicts is essentially as a substitute for artillery. Aerial attacks on enemy forces that are in close proximity to the battlefield (and therefore to the friendly forces), is one example of this type of use of air power. This use of air power, which does not rely on surprise or concealment, but rather can come to be expected by the opposing forces, would not be considered modern.

Common Features

If we look across the different uses of air power, we can see a pattern emerge between the modern uses of strategic attack, interdiction and close air support. Across the different types, the targeted use of air power stands out as a defining quality of the

modern system. Essentially, whether it is strategic attack, interdiction or close air support being used, when the style of war-fighting used is modern, the main aim is to use air power against key, decisive targets. Modern air power, across the different types, does not seek to destroy all of the enemy's forces, but rather to cripple them by hitting essential points that will have repercussions on other aspects of the enemy's forces. This targeted use of air power differentiates the modern system from the non-modern style of using air power to bomb indiscriminately, or of using it as a punitive resource during war.

Table 3.2: Modern and Non-Modern Uses of Air Power

	Modern	**Non-Modern**
Strategic Attack	• Centers of gravity specifically targeted • Limited, short-term indirect collateral damage • Non-military production not damaged • Targets away from the enemy's homeland	• Enemy's homeland targeted • Civilians targeted • Non-industrial urban targets • Attack is punitive in character
Interdiction	• Lines of communication targeted • Defenses avoided • Infrastructure targeted • Temporary windows of opportunity created • Non-combat military units (ie headquarters) targeted • Source of troops or materiel targeted	• Combat forces are targeted • Vehicles used to transport troops or supplies along the conduit targeted • Aim is the attrition of enemy forces and materiel, while in transit • Air power used to slow down enemy pursuing forces in retreat
Close Air Support	• Used at decisive points in battle • Apply concentrated combat power and saturate defenses • Targets are beyond the range of troops in contact • Selective and discriminating firepower	• Air power used as a substitute for artillery • Aerial bombardment of the enemy line • Attack preparatory to an offensive • Attack on troops "crossing the wire" • Air power used to hold a flank

The Effectiveness of the Modern System

At this point, having reviewed what the modern system entails, I will further explore the meaning of employing the modern system of warfighting. Its largest advantage comes from it being able to multiply the effect of whatever amount of forces and resources is being used in the fighting, thus making it less costly to conduct the war. As Luttwak (2001) states, using this sort of strategy can result in disproportionately high gains, given the amount of resources used. Thus, it allows even the weaker (capabilities-wise) side to have a chance at victory. In a bargaining sense, this puts the country that is using the modern system in a more advantageous position, as fighting is less costly for them. It also introduces an element of uncertainty to the interaction between the two states, as military strategies are more difficult to quantify than material capabilities.

It thus would seem to be the case that states should always want to employ the modern system. If employing a particular sort of strategy means that results are greater than the resources that are applied to it, we should expect all states to use that particular strategy, and thus to observe them converging in an equilibrium in which both sides use the modern system. As this has clearly not been the case in history, there have to be some drawbacks to using the modern system. Two appear to be the most important weaknesses of the modern system: its increased risk and its qualitative demands.

As Luttwak (2001) states, if one side is relying on the success of an operation that applies force to what is believed to be a key vulnerable point of the enemy's forces, the failure of that particular operation could lead to the collapse of all related operations that depended on that one success. Because the modern system can rely on getting a very large amount of moving parts to key places, any problem could easily result in chaos (S.

Biddle 2004). The modern system relies on overwhelming a particular weak point and leading to the collapse of the enemy. The point of it is not to overwhelm the enemy as a whole. Thus, if (through misinformation, for example) that one key point is unexpectedly strong, the modern attack may fail. As Biddle states, the modern system is "complex and unforgiving" (S. Biddle 2004, 47), which means that if there is a lack of coordination, one's forces can end up exposed to the enemy's firepower, with lethal consequences. For example, in the case of modern defensive operations, coordinating the moving parts of deep reserves is much more difficult than having a static defense, and may even have an adverse effect on the morale of the troops, who may feel isolated and exposed (S. Biddle 2004). In contrast, under the non-modern system, missing a single target will not jeopardize the entire operation, or place a disproportionately high number of troops at risk (Luttwak 2001). Under the non-modern system there is much less of a risk of a smaller force finding itself overwhelmed by the enemy, as in this case forces are rarely matched against much larger enemy ones.

Biddle (2004) also makes the point that engaging in limited aims attacks, while it may be thought of as less risky in the short-run (as there are likely to be less casualties as there would be from a full-out attack), may prove to be riskier in the long run. This is the case because limited-aims attacks usually do not destroy the opponents, but rather defeat them through the exploitation of a temporary advantage. This means that the opponent remains in the field, which could mean that they can recover and then come back to draw the other side into a much longer war with uncertain consequences. This means that states may be wary of reaching a settlement without winning an absolute victory. It can always be the case that as the balance of power changes in the future or the leadership of

the opponent changes, the opponent will not stick to the settlement and may try to continue fighting in order to obtain a more favorable outcome (Reiter 2009).

The case of Operation Market Garden in World War II provides us with a clear example of how the modern system can be risky, and how a few mistakes and unexpected events can result in an outcome that is much costlier than if the non-modern system had been used. Operation Market Garden was an operation carried out by Allied forces in September of 1944. Its aim was to flank the German defensive line known as the West Wall. In line with the modern system, the aim of operation Market Garden was to avoid the German defenses and drive into the industrial heartland of Germany (a key target that should have had disproportionately large effects on the German system). The first part of the operation involved two American (the 82nd and 101st) and one British (the 1st) airborne divisions to be dropped behind enemy lines (again, bypassing defenses) in order for them to seize eight key bridges in the Netherlands. Once these bridges were seized, the second part of the operation involved the British 30th Army Corps advancing rapidly (again, relying on speed as the modern system would suggest) into Germany through a single highway that went past all of the towns and bridges captured by the airborne troops (Swanston & Swanston 2007).

Problems began when a large proportion of the British paratroopers were dropped safely, but over seven miles away from their intended drop zones. This, combined with the fact that the majority of their jeeps were lost in glider crashes meant that they were significantly slowed down and unable to secure the bridges according to schedule. Only the leading battalion was able to reach the bridge in Arnhem. Further problems arose when that battalion's radio sets did not work and commanders were unable to

communicate with each other. Without the bridges captured, and with anti-tank positions on the highway, 30th Corps' advance was slowed down. These problems resulted in the men defending the bridge having to surrender, troops that had been expecting the 30th Corps to be left without support, and the 1st Airborne having to evacuate with only 2,500 out of the 10,000 troops that it had come in with (Swanston & Swanston 2007). Thus, we can see how an operation that is depending on momentum, avoiding defenses and destroying key targets may be risky, as minor problems can cause the whole operation to fail.

The other, perhaps more obvious, drawback to the modern system is that it can be prohibitively difficult to implement, making it an unrealistic choice for various states. For example, when we think about aerial strategic bombing, the modern system would dictate that key, specific targets should be bombed, expecting them to have repercussions on the rest of the system. The problem in this case is that this sort of surgical bombing requires a certain level of military technology that is not available to all states (or that has not been available throughout time; simply consider how modern technology has enabled developed states to reduce the amount of collateral produced through aerial bombing). Even going beyond technology, implementing the modern system is also qualitatively demanding on the personnel expected to carry the strategy out. According to Luttwak (2001), only high-quality units can be used to effectively carry out a successful targeted strategy. Thus, even if a state manages to acquire the weapons needed to carry out a modern strategy, if its troops are not adequately trained it will not be able to carry out the strategy. The modern system is one in which quality matters, and cannot be made up for in quantity (Luttwak 2001).

A Model of Strategy Choice

We can begin to think of modeling the effectiveness of the modern system of air power at the individual state level, at which a single state makes the decision to use either the modern or the non-modern system of air power.

I will assume that the state of interest, the coercer (we will refer to it as State A) is in a situation in which it is attempting to, through the use of air power, coerce another state that it is engaged in an armed conflict with[15]. State A will then choose the proportion of "modern" strategy that it wants to use[16]. I am assuming that states can incorporate aspects of both the modern and non-modern systems into their military strategy, so that they can range from using a pure non-modern strategy to a pure modern one, allowing for all different proportions in between.

The aim of the state is to maximize its probability of victory. I assume that the state derives positive utility from victory, such that it will derive higher utility from higher probabilities of victory than it would from low probabilities of victory. I begin with the premise that achieving coercive success is in part dependent on the coercer state's capabilities. This is a rather uncontroversial assumption. It basically says that, all else being equal, states that have higher material capabilities (larger military, greater industrial capacity, higher GDP's, etc) will be more likely to get other states to do what

[15] This of course leads to a selection bias in the study, as I will be looking only at the cases in which two countries have already engaged in armed conflict, a selection which is surely not random. Unfortunately, if we want to be able to study the effect of using particular forms of air power on the outcome of conflicts, we cannot observe the effects of aerial power strategy in cases in which the strategy was not actually used. Pape (1996) categorizes strategy in threat-only cases based on the capabilities of the attacking state. I believe that this approach could not be used in this project, as often the same aircraft can be used for both modern and non-modern strategies.

[16] Again, in this case the analysis will be limited to the cases in which states have air forces that they can use in conflict. While this is obviously not a random selection of states, it would not make sense to study the use of air power by states that do not have an air force at their disposal.

they want them to. This will be the case because they can threaten to inflict greater harm on states that do not comply with their wishes. They can make larger threats that are credible, as these states will have the capacity to carry the threats out.

This means that the utility function of the state will be dependent on its capabilities, with higher capabilities making victory more likely:

U(Victory)=f(cap)

Of course, the entire premise of this dissertation depends on the fact that coercive success, particularly when using air power as the tool of coercion, depends not only on capabilities, but also on how the air power is being used, on what the strategy is. Thus, the utility function should be a function of not only capabilities, but also strategy

U(Victory)=f(cap, strategy)

We can refine this idea by thinking of whether a state uses the modern system of warfare in the air or not. We can recall that earlier in this chapter we discussed how using the modern system effectively may serve as a force multiplier, allowing one attack to have effects beyond the magnitude of its target, based on the strategic significance of the target. This has two implications. The first is that the modern system requires less resources, and therefore is less costly to use. We can think of how using a single aircraft to bomb one bridge would be much less costly than using various aircraft in an extended

bombing campaign to annihilate all the enemy's troops[17]. The second implication is that the state that is using the modern system could end up with an extremely favorable outcome, where it is able to quickly obtain the concessions it wants from its opponent without having to engage in a long and bloody war.

Of course, the flip side of this argument is (again, as discussed earlier) that using the modern system can also be riskier (recall the examples of how campaigns that rely on effectively destroying a particular target can go very wrong if key operations fail). Thus, what the modern system is in essence doing is increasing the variance of the distribution of potential outcomes in a conflict. States that use the modern system can end up with a very positive outcome, or an extremely negative one[18]. States that use a non-modern system will have a smaller variance in their outcomes. They may end up with negative outcomes, but even these bad outcomes will not be as bad as they could potentially be under the modern system (if there are a variety of bombing raids on the enemy's trenches planned and one of them fails, we still should expect the state to be able to recover from it). Thus, we can now think of the state is trying to maximize a utility function that is dependent not only on its capabilities, but also on the ratio of modern and non-modern strategies that the state in question is using. We can think of this degree of risk being represented by the modern system variable having greater variance than the non-modern one:

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[17] Of course, one might argue that training pilots to be able to precisely target the bridge is much more costly than just training them to carpet-bomb troops, but these are costs that have been incurred in the past and that should not affect decisions in the present.

[18] An implicit assumption being made here is that outcomes of military campaigns or conflicts go beyond just being "victory" or "defeat." Rather, there is variation within these categories. A victory can be overwhelming, or it can come close to being a draw. Clearly, all else being equal, states would prefer an overwhelming victory.

U(Victory)=f(cap, M, NM)

To begin, we will have a utility function, U, that represents the utility a given state is getting from a particular conflict outcome. I assume that the state prefers victory over defeat, such that the variable "V" represents a positive payoff from victory. As we discussed before, the state can make any proportion of its aerial strategy modern. This will be represented as "m," with the proportion of the strategy that is not modern being represented as "n." The general idea is that there is a total amount of air power that the state can use, and that it will distribute it between the two different strategies. We can think of this total amount as a budget or capability restriction, and it will be represented as "B." There is some form of cost associated with using either one of the strategies, which is represented as "c". As stated before, I will assume that the cost of using the modern system, c_M, will be less than that of using the non-modern system, c_N, such that:

$$C_M < C_N$$

The cost is then multiplied by the amount of either modern or non-modern that the state is using. There will also be a probability function associated with both the modern and the non-modern system that will give us the probability of victory, given that particular system being used. This probability of victory, multiplied by the value of victory, gives us the expected payoffs from using a particular amount of modern strategy. Thus, our utility function will be as follows:

$$U = m[-m * c_M + \Pr(V|m) * V] + n[-n * c_N + \Pr(V|n) * V] \quad \{\text{Equation 1}\}$$

Subject to the constraint that

$$m + n = B \quad \{\text{Equation 2}\}$$

To incorporate the budget/capability constraint into Equation 1 we can use the Lagrangian multiplier such that

$$L = m[-m * c_M + \Pr(V|m) * V] + n[-n * c_N + \Pr(V|n) * V] + \lambda(B - m - n) \quad \{\text{Equation 3}\}$$

Because we want to know what amount of modern and non-modern air power a state would use in order to maximize its utility obtained from the conflict, we should maximize the function U. We will begin by maximizing the Lagrangian function, taking its partial derivatives with respect to both of our key variables (amounts of modern and non-modern airpower), setting them equal to zero, and solving for both m and n:

$$\frac{\partial L}{\partial m} = -2m * c_M + Pr(V|m) * V - \lambda = 0$$

$$m = \frac{Pr(V|m) * V - \lambda}{2c_M} \quad \{\text{Equation 4}\}$$

And

$$\frac{\partial L}{\partial n} = -2n * c_N + Pr(V|n) * V - \lambda = 0$$

$$n = \frac{Pr(V|n) * V - \lambda}{2c_N} \quad \{\text{Equation 5}\}$$

We can also take the partial derivative with respect to λ,

$$\frac{\partial L}{\partial \lambda} = B - m - n = 0$$

Since,

$$B = m + n = \frac{Pr(V|m) * V - \lambda}{2c_M} + \frac{Pr(V|n) * V - \lambda}{2c_N}$$

Then,

$$\lambda = \frac{-2Bc_Mc_N + c_NV*\Pr(V|m) + c_MV*\Pr(V|n)}{c_M + c_N} \quad \{\text{Equation 6}\}$$

So that we can solve for m and n:

$$m = \frac{2Bc_N + V[\Pr(V|m) - \Pr(V|n)]}{2(c_M + c_N)} \quad \{\text{Equation 7}\}$$

And

$$n = \frac{2Bc_M + V[\Pr(V|n) - \Pr(V|m)]}{2(c_M + c_N)} \quad \{\text{Equation 8}\}$$

From these equations we can derive some very basic (and intuitive) hypotheses about when states will derive more utility from using a given aerial strategy.

If we look at equation 7, which tells us the proportion of the state's strategy that will be modern, we can see that as the budget increases (all else being equal), the amount of strategy that will be modern will increase, as will the non-modern strategy.

Hypothesis A: All else being equal, as the capabilities or budget of a state increase, so will the amount of modern (non-modern) strategy that it uses.

We can also see that as one strategy becomes relatively costlier, the other strategy will tend to be preferred.

Hypothesis B: As the cost of the non-modern (modern) strategy increases, the amount of modern (non-modern) strategy that a state uses will increase.

Finally, and perhaps most importantly, we can see that as the difference in the probability of success given that the modern strategy is used and the probability of success given that the non-modern strategy is used increases (and I assume that this difference is positive), the amount of modern strategy used increases.

Hypothesis C: As the probability of victory given that the modern (non-modern) system is used increases relative to the probability of victory given that the non-modern (modern) system is used, the amount of modern (non-modern) strategy will increase.

These previous hypotheses tell us some general information about when any given strategy would be chosen over another one, but now we have to think in particular about what they can tell us about using a particular aerial strategy. In order to do this I will begin by integrating into the equations the greater variance in outcomes that the modern system has, relative to the non-modern system. We can think of the outcomes from using either strategy as being distributed as a Normal (Gaussian) distribution, such that:

$$\Pr(V|m) = \frac{1}{\sigma_M\sqrt{2\pi}}^{\frac{-(V-\mu_M)^2}{2\sigma_M^2}}$$

And

$$\Pr(V|n) = \frac{1}{\sigma_N\sqrt{2\pi}}^{\frac{-(V-\mu_N)^2}{2\sigma_N^2}}$$

Where

$$\sigma_M > \sigma_N$$

This previous assumption is important because it represents the greater variances in outcomes when using the modern system. In other words, we can think of outcome as

being simply defeat or victory, but the fact is that not all defeats and victories look the same for the states involved in them. A victory can be an overwhelming victory, or it can be closer to a tie. The same is true for a defeat. Thus, we can think of outcomes as a continuum, with overwhelming defeats at one end, overwhelming victories on the other, and stalemates in the middle. I argue that using a modern strategy will lead to greater variance in outcomes along this continuum.

Thus,

$$m = \frac{2Bc_N + V[(\frac{1}{\sigma_M\sqrt{2\pi}}^{\frac{-(V-\mu_M)^2}{2\sigma_M^2}}) - (\frac{1}{\sigma_N\sqrt{2\pi}}^{\frac{-(V-\mu_N)^2}{2\sigma_N^2}})]}{2(c_M + c_N)} \quad \text{\{Equation 9\}}$$

And

$$n = \frac{2Bc_M + V[(\frac{1}{\sigma_N\sqrt{2\pi}}^{\frac{-(V-\mu_N)^2}{2\sigma_N^2}}) - (\frac{1}{\sigma_M\sqrt{2\pi}}^{\frac{-(V-\mu_M)^2}{2\sigma_M^2}})]}{2(c_M + c_N)} \quad \text{\{Equation 10\}}$$

To simplify our equations we can even think of σ_M as being equal to σ_N multiplied by a given factor that is greater than 1, such that:

$$\sigma_M = \sigma_N * \varepsilon$$

Where

$$\varepsilon > 1$$

Such that,

$$m = \frac{2Bc_N + V[(\frac{1}{\varepsilon\sigma_N\sqrt{2\pi}}^{\frac{-(V-\mu_M)^2}{2(\varepsilon\sigma_N)^2}}) - (\frac{1}{\sigma_N\sqrt{2\pi}}^{\frac{-(V-\mu_N)^2}{2\sigma_N^2}})]}{2(c_M + c_N)} \quad \text{\{Equation 11\}}$$

And

$$n = \frac{2Bc_M + V[(\frac{1}{\sigma_N\sqrt{2\pi}}^{\frac{-(V-\mu_N)^2}{2\sigma_N^2}}) - (\frac{1}{\varepsilon\sigma_N)\sqrt{2\pi}}^{\frac{-(V-\mu_M)^2}{2(\varepsilon\sigma_N)^2}})]}{2(c_M + c_N)}$$ {Equation 12}

Assuming that states want to maximize the utility that they obtain from fighting an armed conflict, we can use the two previous equations to derive some hypotheses about the circumstances under which states should derive the most utility from using the modern system.

If we assume that the mean value (μ) of the outcome is the same whether a state is using the modern system or the non-modern system ($\mu_M = \mu_N$), then we can see that as the value of ϵ increases, the proportion of strategy that will be modern (m) will decrease[19]. This means that if the mean value of the outcome of the conflict is the same for both strategies, states will derive less utility from using the modern system, relative to the non-modern system. In general, I have assumed that the modern system has greater variance than the non-modern system, but as that difference in variance increases, all else being equal, states will be less likely to use the modern system. As I am assuming that they are risk averse, such that when given two options were equal expected payoffs, they would choose the one with lower variance in potential outcomes. Thus, we can derive the next hypothesis:

[19] I will make the assumption that when states are engaged in conflict they will behave in a risk-averse fashion, such that given two options with the same expected utility, the will choose the one with the lower amount of variance in outcomes.

Hypothesis D: If the mean values of both strategy systems are the same, as the difference in variance between the modern and the non-modern system increases, states will be less likely to use the modern system.

Of course, as the mean value of one system increases (all else being equal), that one system will be more likely to be used. This means that as the mean value of using the modern system increases, states should be more likely use the modern system.

Hypothesis E: In conflicts in which the mean expected value of using the modern system is greater, states are more likely to use the modern system.

CHAPTER 4: DATA

This chapter describes the data to be used to test my hypotheses. My dataset will be based on Allen (2007). In her 2007 paper "Time Bombs" she augmented the data of Horowitz and Reiter (2001) and Pape (1996). The data used by Allen (2007) includes all coercive bombing campaigns in international conflicts, up to 2003.[20]

Based on the theory developed in the previous chapter, my empirical analysis requires data on battlefield success. In this dissertation I will argue that the way that the forces are employed (both on the ground and on the air), the military strategy, will make success more or less likely[21]. The actual data used to measure success will be derived from Horowitz and Reiter's 2001 piece on aerial bombing, with additional cases coded according to their coding rules[22]. Their coercive success variable (which is in turn based off of Pape's 1996 work) is dichotomous, coded 1 if the demands of the attacker were met and 0 otherwise.

My main independent variable will be a measure of whether the aerial strategy being used in this case is modern or non-modern. There is no existing dataset that

[20] At the moment I have gone through and coded my key independent variables for all of the cases in Allen's dataset. While involved in this process I have discovered a few missing cases, as Allen (2007), Horowitz and Reiter (2001) and Pape (1996) focus exclusively on cases of strategic bombing, and I am hoping to include also cases of close-air support and interdiction. An avenue for future research would be to add these other cases to the data, as well as some that go beyond 2003.

[21] There has been some discussion in the literature over whether countermilitary targeting can be considered coercion, as some argue that bombing military targets is simply using brute force against the enemy, not altering their will to fight (George, Hall and Simons 1971). I will take the view that countermilitary targeting may be part of a coercive campaign, as it is rarely the case that countermilitary bombing completely eliminates the ability of the enemy to resist, but rather can force them to reevaluate their gains from continuing to fight and lead to their surrender (Byman, Waxman and Larson 1999, Horowitz and Reiter 2001, Pape 1996).

[22] I recently (early April 2011) talked to Susan Allen about the new dataset on aerial bombing that she has been putting together. This dataset includes newly-coded variables that define coercive success in terms of both the military and political aims of the attacker. I believe that this would be a superior measure to use in future work, once it is published

includes a coding for this variable, so collected these data from primary documents (e.g. the official published military doctrines of various states) and historical accounts of conflict. I begin by categorizing the use of air power as close air support (CAS), interdiction, or strategic attack. According to the USAF Basic Doctrine, CAS provides direct support to friendly forces that are already in contact with enemy forces, and aids them in achieving their objectives. Interdiction is directed against targets that are contributing to reinforcing the land battle, whereas strategic attack targets the enemy as a system, not just on the field (Air Force Basic Doctrine 2003).[23]

I developed a series of questions that refer to key characteristics of each of the three forms of air power. Each is answered yes or no. I derived each question from the definition of interdiction, close air support, or strategic attack that I am using in this study. These definitions were in turn (as described in Chapter 3) drawn from Air Force documents that defined these uses, such as the Air Force Doctrine and publications on counterland operations (Chapter 3 includes the particular definitions, as well as the sources I drew them from). All questions refer to how the attack was carried out, as opposed to the plans or intentions of the state conducting the attack. The main reason for making this decision is that I am attempting to explain how military strategies affect the duration and outcome of a conflict. Thus, this refers to the way in which the strategy was actually used, not how it was intended to be used. The strategy that the opponent observes, and uses to acquire information about the state carrying out the bombing campaign, is the strategy that was actually employed. Also, states may not always be sincere about what their intended strategy is, which makes coding an intended strategy difficult.

[23] All three of these terms are defined in detail in the Chapter 3 of this dissertation.

To provide an, one of the questions under the close air support category is as follows, "Is the attack carried out at a range from the battlefield within which terminal attack control is required for fratricide prevention?" If the answer to the question was yes, I took that to be indicative of uses of air power being interdiction, as a key characteristic of interdiction is that it is far enough from the battlefield so as to not require ground forces to have terminal attack control. The same process was repeated for all of the questions. The responses from these questions then allow me to determine whether the dominant use of air power was interdiction, close air support or strategic attack (I considered a case to be a dominant use of air power if more than half of the responses under that category were coded as 1). In cases in which more than one form of air power was used, I code all forms of air power. I included coding for all cases, even those that were later not included in some of the analysis (for example, cases of bombing against non-state actors). The following three tables show the distribution of "yes" answers for each type of use of air power, as long as the mean values for each question (because each questions took on a value of either 1 or 0, the mean values can be also thought of as the percentage of "yes" answers).

Table 4.1: Questions to Determine Type of Air Power, Interdiction

	Question	Frequency of "Yes"	Mean Value
Interdiction	Are air operations being conducted to divert, disrupt, delay, or destroy the enemy's military potential before it can be brought to bear effectively against friendly forces or otherwise achieve objectives?	29 cases	.60
	Is the distance of the use of air power far enough from friendly forces that detailed integration of the air mission with friendly forces is not required? friendly forces or otherwise achieve objectives?	39 cases	.85
	Are targets military resources that the enemy could have used against the nation in question?	27 cases	.56
	Is air power directed against targets that are contributing to reinforcing the land battle?	20 cases	.43
	Is the aim of the attack to cut off ground forces from command and supply lines in order to make them more vulnerable to attack?	10 cases	.21
	Are the targets lines of communication whose destruction would impede the movement of the enemy's forces (for examples, bridges or highways that the enemy needs to cross in order to conduct an attack)?	12 cases	.44

Table 4.2: Questions to Determine Type of Air Power, Close Air Support

	Question	Frequency of "Yes"	Mean Value
CAS	Is the air action against hostile targets that are in close proximity to friendly forces?	16 cases	.34
	Is detailed integration of missions with friendly ground forces required?	12cases	.26
	Is the attack carried out at a range from the battlefield within which terminal attack control is required for fratricide prevention?	11 cases	.24
	Is air power being used in preparation for battle?	24 cases	.50
	Is air power being used as reinforcement of attacks on the ground?	24 cases	.51

Table 4.3: Questions to Determine Type of Air Power, Strategic Attack

	Question	Frequency of "Yes"	Mean Value
CAS	Is the aim of the attack to affect the enemy's leadership, conflict-sustaining resources and strategy?	23 cases	.48
	Is the use of air power aimed at destroying resources that will weaken the enemy and its ability to prosecute the war?	28 cases	.58
	Is the attack carried out at a large distance from the battlefield	37 cases	.76
	Does the attack aim to target the enemy's sources of strength without first having to engage military forces?	35 cases	.71

	Is the attack intended to attack the enemy as a system, not just on the battlefield?	35 cases	.71

Having determined the form(s) of air power that is (are) being used, I then go on to ask an additional set of questions to determine whether a particular case can be categorized as a "modern" use of air power. As discussed in Chapter 3 (the theory chapter), I identified the characteristics of modern and non-modern air power under each one of the three forms of air power. The questions in each section identify the key characteristics of modern and non-modern air power, with again each one being answered in the affirmative or negative. To provide another example, one of the questions under the modern interdiction section asks, "Are lines of communication and transportation (bridges, highways) being targeted?" Targeting the lines of communication and cutting off the enemy's troops from their command and control is one of the key elements of the modern system. Under the non-modern interdiction section, a sample question reads, "Are combat forces (i.e. the actual troops, tanks, etc) being targeted?" (under the traditional, non-modern form of fighting the aim of attack is to destroy the actual troops so that they will no longer be able to resist).

Below, as Table 4.4, I reproduce the table from Chapter 3 that includes the different characteristics of both modern and non-modern forms of all three uses of air power. The actual questions are included in the raw data in Appendix A. To ensure that each question was actually reflecting how modern that particular use of air power was, I derived the questions from descriptions of targeted air power (analogous to Biddle's modern system) from Warden's "The Air Campaign," as well as Air Force documents on Counterland Operations (these documents are described in more detail in Chapter 3,

where I define what the modern and non-modern versions of all three types of air power are).

Table 4.4: Modern and Non-Modern Uses of Air Power

	Modern	Non-Modern
Strategic Attack	• Centers of gravity specifically targeted • Limited, short-term indirect collateral damage • Non-military production not damaged • Targets away from the enemy's homeland	• Enemy's homeland targeted • Civilians targeted • Non-industrial urban targets • Attack is punitive in character
Interdiction	• Lines of communication targeted • Defenses avoided • Infrastructure targeted • Temporary windows of opportunity created • Non-combat military units (ie headquarters) targeted • Source of troops or materiel targeted	• Combat forces are targeted • Vehicles used to transport troops or supplies along the conduit targeted • Aim is the attrition of enemy forces and materiel, while in transit • Air power used to slow down enemy pursuing forces in retreat
Close Air Support	• Used at decisive points in battle • Apply concentrated combat power and saturate defenses • Targets are beyond the range of troops in contact • Selective and discriminating firepower	• Air power used as a substitute for artillery • Aerial bombardment of the enemy line • Attack preparatory to an offensive • Attack on troops "crossing the wire" • Air power used to hold a flank

Again, the coding referred to the actual targets that were bombed, not to the intent, which could be interpreted more ambiguously.

Across the different uses of air power (CAS, interdiction, strategic), the targeted use of air power stands out as a defining quality of the modern system. Essentially, whether it is strategic attack, interdiction or close air support being used, when the style

of war-fighting used is modern, the main aim is to use air power against key, decisive targets. Modern air power, across the different types, does not seek to destroy all of the enemy's forces, but rather to cripple them by hitting essential points that will have repercussions on other aspects of the enemy's forces. In the case of interdiction, the targeted use of air power differentiates the modern system from the non-modern style of using air power to bomb indiscriminately, or of using it as a punitive resource during war.

In the case of strategic attack a modern aerial attack refers to campaigns with limited aims and little collateral damage that target centers of gravity, attempting to impair the opponent's ability to wage war (but not significantly damage non-military production). This can be contrasted with the more punitive non-modern aerial strategic attacks that can emphasize area bombing over the centers of gravity (Warden 2000). Modern interdiction is also more selective, focusing attacks on the support infrastructure, lines of communication and command and control, in an attempt to destabilize the opponent. Non-modern interdiction involves the more general bombing or enemy forces (fielded forces, for example) and materiel. Finally, close air support, which is usually thought of as non-modern when it is used as a substitute for artillery, can be modern when selective firepower is applied to targets beyond the range of ground troops.

To illustrate this preliminary stage of coding, I discuss Operation El Dorado Canyon, the US bombing campaign against Libya carried out in 1986 in response to the Libyan-sponsored terrorist bombing of a West Berlin discotheque frequented by American military personnel that left 3 people dead and over 200 injured (Global Security.org n.d.). This was coded as strategic attack. Three out of the five questions referring to strategic attack (the attack was intended to destroy resources that would

weaken Libya's ability to conduct attacks, it aimed to target Libyan sources of strength without engaging military forces, and aimed to attack Libya as a system rather than on the battlefield) had "yes" responses, zero of the questions on close air support had "yes" responses (the U.S. did not have any ground troops present in Libya), and only one question on interdiction had a "yes" response (the attack destroyed terrorist military potential before it could be brought to bear against American targets).

Table 4.5: Questions to Determine Degree of Modern Strategic Attack (Operation El Dorado Canyon, 1986)

	Question	Response
Modern	Are centers of gravity being targeted?	No (0)
	Does the attack cause a limited amount of indirect collateral damage and not have a long-term impact on the civilian economy?	Yes (1)
	Are targets selected to impair the enemy's ability to wage war but continue non-military production without much disturbance?	Yes (1)
	If there is aerial bombing used, is it on targets away from the enemy's homeland?	No (0)
Non-Modern	If fighting is not occurring in the enemy's homeland, is the homeland still being targeted?	Yes (1)
	Are civilians being targeted	Yes (1)
	Are non-industrial urban areas being targeted?	Yes (1)
	Is the campaign punitive in character?	Yes (1)

While President Reagan stated that the action was one of self-defense, in most historical accounts it is referred to as a punitive attack in retribution for the Berline bombings. The attack was one on the Libyan homeland. The targets were both military and civilian (though the official US stance was that only the military targets were intentional). The military targets were mainly terrorist training facilities and airfields (to ensure that Libyan MiG fighters would not attack US aircraft). These do not fall under the category of centers of gravity. These targets were limited, and designed to impair the terrorist attack capabilities of the Libyan government, but allow non-terrorist production to continue. Collateral from the attack, despite there being civilian casualties that received much press attention, was limited and did not have a long-term impact on the civilian economy. Diplomatic and civilian sites in Tripoli were hit (again, these were likely unintentional, but as I am coding observed actions I included the raid as having hit civilian targets in non-industrial urban areas). One of the compounds was the Bab al-Azizia compound, where Qaddafi and his family lived. Again, because some of these intended targets were civilians, the case was coded as including civilian targets.

Another coding example is that of Britain bombing Somali rebels in 1920 during an uprising in British Somaliland led by Mohammed bin Abdullah Hassan, the Mad Mullah, who had been conducting anti-British operations in East Africa since 1899. After ground forces alone proved unable to stop the Mullah, aircraft were deployed to the area. The aim of the campaign was to bomb the military forts held by the Mullah, as well as his supporters (with the expectations that this would drive them towards British ground

troops). This case was coded as being predominantly interdiction[24]. Despite there being British ground forces present, the aerial attacks were not close enough to (or coordinated enough with) them to consider this use of air power as close air support. The campaign was also not a strategic one, as it was clearly fighting the Mullah's military forces, not the Somali system as a whole. Table 4.6 displays the coding of this air campaign.

Table 4.6: Questions to Determine Degree of Modern Interdiction (Britain vs. Somali Rebels, 1920)

	Question	Response
Modern	Are the targets non-military (ie bridges, roads, warehouses)?	No (0)
	Are lines of communication and transportation (bridges, highways) being targeted?	No (0)
	Are defenses avoided (going directly to center of gravity)?	Yes (1)
	Is the support infrastructure (supply lines) being targeted?	No (0)
	Is the aim of the attack to create a temporary window of opportunity that can be taken advantage of by ground forces?	No(0)
	Are non-combat military units, such as headquarters, being targeted?	No(1)
	Is the source of troops or materiel being targeted?	Yes(1)

[24] Four out of six questions on interdiction are answered "yes," whereas only two out of five on CAS have "yes" responses, and two out of five on strategic attack have "yes" responses. The attack was meant to divert Somali military potential before it could be brought to bear against British troops, the attacks were far enough for British troops that detailed integration with friendly forces was not required, attacks were against military resources that could have been used against the British, and the targets of the attacks were reinforcing Somali ground forces.

Non-Modern	Are combat forces (ie the actual troops, tanks, etc) being targeted?	Yes (1)
	Are vehicles used to transport troops or supplies along the the conduit being targeted?	Yes (1)
	Is the aim of interdiction the attrition of enemy forces and materiel?	Yes (1)
	Is air power being used to slow down and enemy that is pursuing forces in retreat?	Yes(1)

In this campaign targets were mostly forts (which are military targets) and the Mullah's fighters (the actual troops, as referred to by one of the questions). Another target of the campaign was camels, which were used as vehicles to transport the Mullah's troops. At one point the Mullah's forces were in retreat, and air power was used to slow them down and drive them towards the British ground forces. These attacks did not engage the defenses of the Mullah directly, but rather bypassed them by bombing the forts, which were the Mullah's source of troops and materiel. The attack did not target roads, lines of communication and supply, or non-combat military units (Dean 1983).

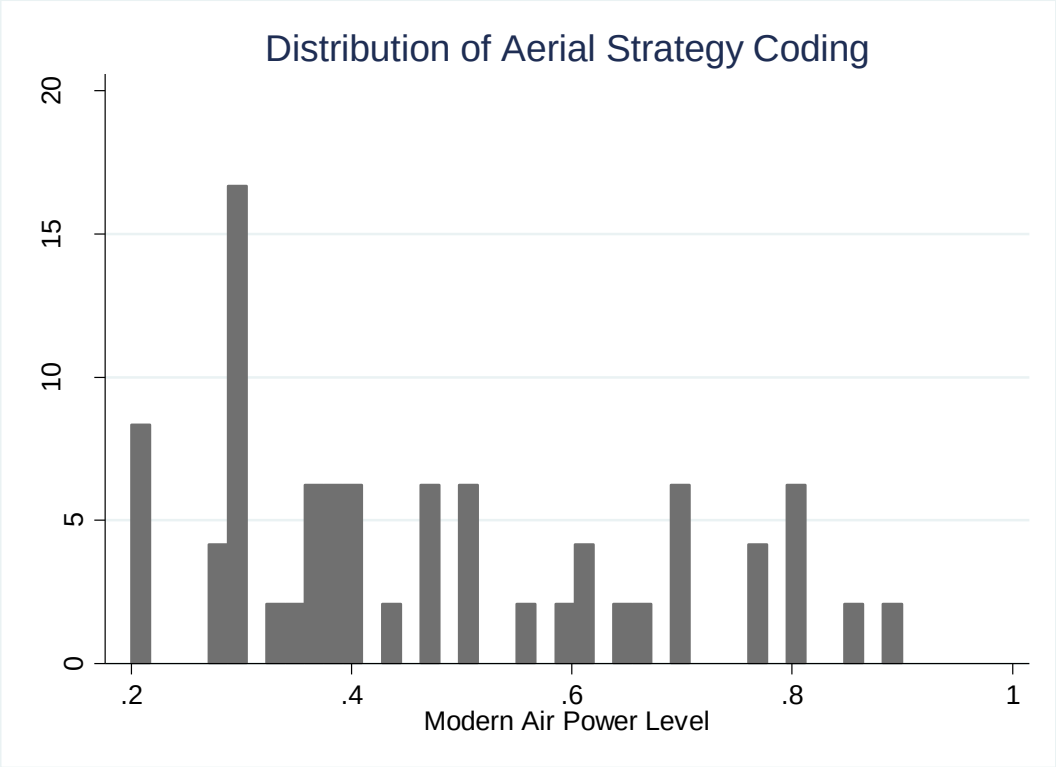
The answers to all of these questions are close to the conceptual definition of modern air power, as I drew the questions from the conceptual definitions described in Chapter 3. Having collected the answers to these questions, I then move on to creating an operational definition of aerial strategy. In particular, I create a single measure of the degree to which a state uses a modern or non-modern strategy. In order to do this, I aggregate the answers to the individual questions to form an overall index of how "modern" a particular use of air power is. In each case, only the answers from the dominant use(s) of air power are considered for that case's classification. Affirmative

answers to questions related to the use of modern air power are added to the score, as are negative answers to the questions referring to the use of non-modern air power. As the number of questions varies between categories, the "modern score" is normalized to a score between 0 and 1, which essentially represents the percentage of questions that indicate the use of the modern system. The higher that number is, the more modern that one particular case can be considered to be.

I created a continuous (rather than dichotomous) measure of modern and non-modern strategies because I believe that aerial strategies always contain aspects of both the modern and non-modern strategies (and the theory developed in chapter 3 represents this belief). A continuous measure allows me to better represent the spectrum of strategy combinations available to states. This measure also gives me the flexibility to create a dichotomous measure from it if the analysis requires it (in some of the analysis in later chapters I do use a dichotomous measure of aerial strategies).

In figure 4.1, I present a histogram with the distribution of additive modern air power scores for the sample. As we can see from the figure below, there are relatively few cases at the higher end of the modern spectrum. The mean value for modern air power level is .47 and the modal category is .3. The standard deviation is .20. Cases on the higher end of the spectrum include campaigns such as NATO's Deliberate Force Operation against the Serbs and the United States' attacks during Desert Storm.

Figure 4.1: Distribution of Aerial Strategies



We can see from the following graphs that not only is there variation in the amount of modern air power that is used by states, but that this variation persists even when we divide the data up by the different uses of air power (CAS, interdiction and strategic attack).

Figure 4.2: Distribution of Modern Close Air Support

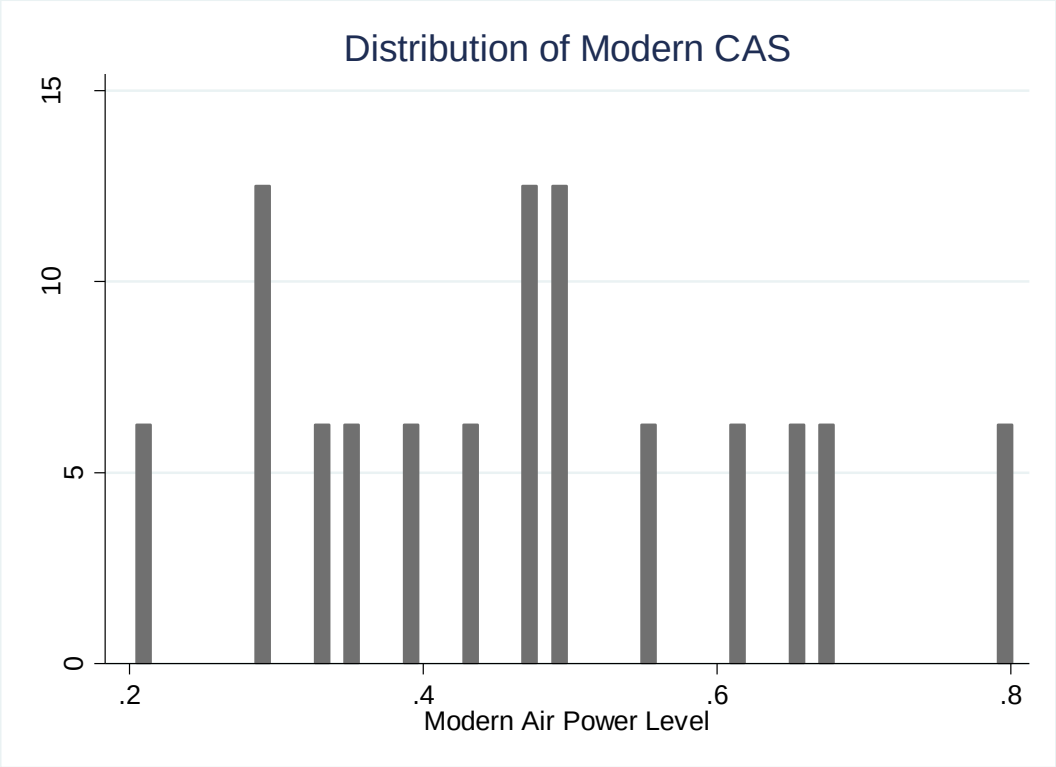


Figure 4.3: Distribution of Modern Interdiction

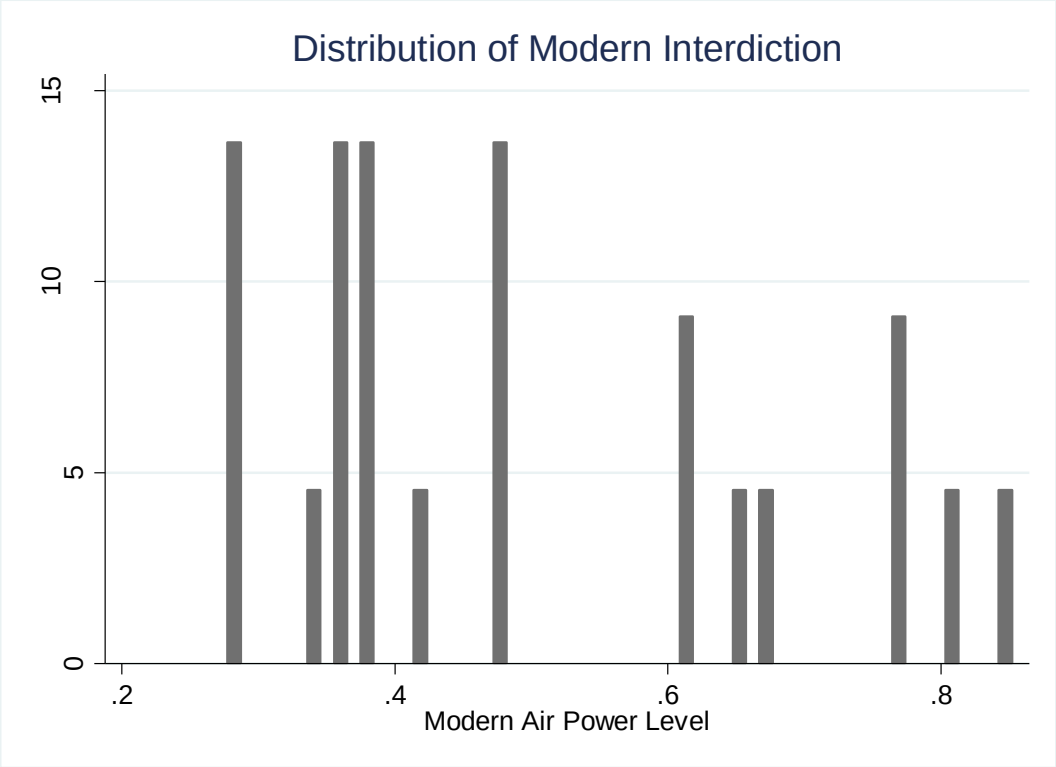
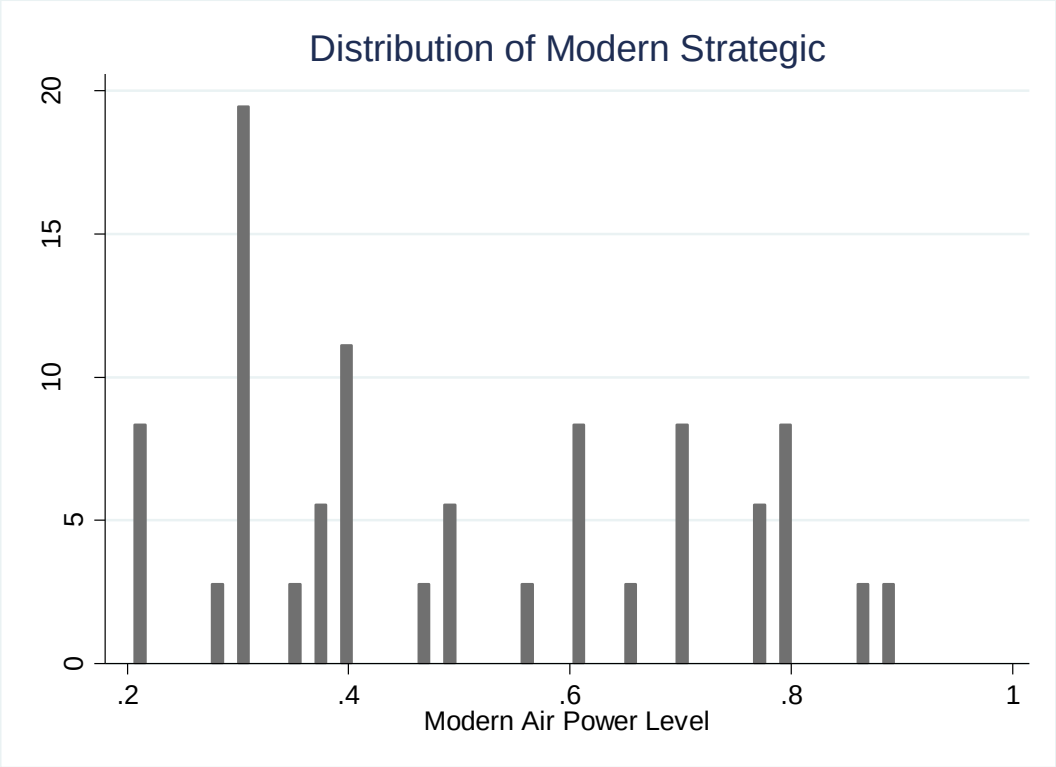


Figure 4.4: Distribution of Modern Strategic Attack



In several of these cases both sides are using air power. There are, of course, a few cases in which only one side used air power. To account for this, I include a variable that determines, for each case, whether the opponent was using air power or not. Asking whether the opponent used air power is also an important question, as it will may allow us to understand whether the effectiveness of air power is dependent on the other side using (or not using) air power. In 30 of the cases, the opponent was using air power, while in 18 it was not.

As far as the categorization of the ground strategies goes, I would have preferred to use an existing dataset, to maintain some uniformity with previous studies. The problem with using past datasets that contain coding for military strategies (Stam 1996, Reiter and Meek 1999) is that while they may be appropriate for the particular studies

that they were built for, in this case they prove problematic. One aim of this study is to evaluate the interaction of military strategies used in the air and on the ground. This means that we need to have separately coded strategies for military strategies in the air and on the ground. The problem with existing datasets is that their coding of military strategies encompasses both strategy on the ground and in the air. This means that using datasets to measure ground strategy would not allow me to accurately measure their interaction with aerial strategies, as they will be affected by aerial strategies, which I am trying to measure separately.

Because of this impediment, I will also include a new coding for ground strategies. This coding will be based on Biddle's definition of modern and non-modern strategies. Similarly to the air power variables, the coding will be based on a series of questions that aim to determine whether the strategy is modern or not. Again, what this variable will try to measure is how modern the ground strategy of a state is, following Biddle's definition. In order to capture this, the questions are drawn directly from Biddle's definition of the modern system. Like the questions on air power, these questions are phrased so as to reduce ambiguity. In other words, they refer to observable actions, such that different coders looking through historical accounts should be able to come up with the same answers. The questions, which are included in Appendix A, are ones such as, "Is the aim of a campaign to seize a strategically important piece of terrain?" or "Is the aim of the attack to exploit temporary advantage/ windows of opportunity?" Below, in table 4.7, I present the questions on ground strategy, as well as the frequency of yes answers.

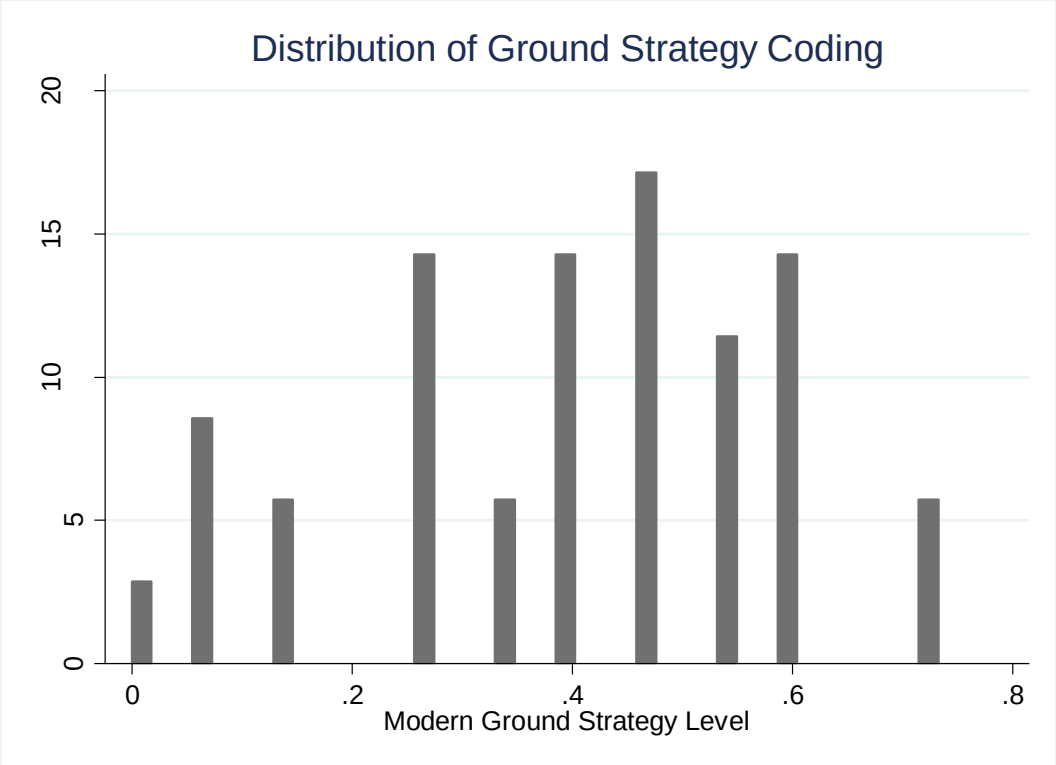
Table 4.7: Questions to Determine Type of Ground Strategy

Question	**Frequency of "Yes"**	**Mean Value**
Does the campaign have limited aims?	14 cases	.40
Are defenses avoided?	11 cases	.31
Is the aim of a campaign to seize a strategically important piece of terrain?	17cases	.49
Is the aim of the attack to exploit temporary advantage/ windows of opportunity?	12 cases	.34
Is cover and concealment (NOT quasi-permanent trench lines, irregular, camouflaged locations, interlocking fields of fire) an important part of the strategy?	9 cases	.26
Are large formations broken up (dispersion)?	18 cases	.51
Are subunits (platoons or sections, not battalions or companies) allowed to move independently?	20 cases	.57
Is the whole operation NOT orchestrated from above?	5 cases	.14
Does terrain allow subunits to move independently?	32 cases	.89
Is suppressive fire emphasized over destructive fire?	4 cases	.11
Is there combined arms integration (teaming together weapon types with contrasting strengths and weaknesses like infantry and artillery)?	21 cases	.60

Is the aim to induce the systemic collapse of a defense while fighting through only a fraction of it directly?	15 cases	.43
Are targets the support infrastructure (supply lines)?	6 cases	.17
Are forces disproportionately concentrated at a given point?	23 cases	.66
Is depth emphasized over density when establishing defense?	2 cases	.06

The answers to the questions are then aggregated into a general measure of how modern the land strategy is. The aggregation is similar to that of the aerial strategy measure of strategy. The "yes" answers are added up (coded as ones) and divided by the total number of questions, which results in a number between zero and one, with values closer to zero representing less modern ground strategies and values closer to one representing more modern ground strategies. The values range from 0 to .73, and the mean value for the modern ground power score is .40. Below is a histogram that shows the distribution of ground strategies across the different cases.

Figure 4.5: Distribution of Ground Strategies



The analysis will also include a variety of variables that are expected to affect whether the coercing state is able to achieve its aims. These will include capabilities of both the attacker and the adversary (as well as the ratio between the two), whether there are allied nations involved in the conflict, and any other ones that may arise in conducting the analysis for each empirical chapter. These measures will thus be further discussed in each chapter.

CH. 5: SELECTING AN AERIAL STRATEGY

Before determining how effective a particular aerial strategy will be under different circumstances, I will begin by exploring what determines how a given state will choose its aerial strategy. This is particularly important in order to address potential problems of endogeneity. When we study the effect of military strategy on conflict, one roadblock that we quickly run into is the question of whether we can really separate the effect of military strategy on outcomes from strategy choice, as we can think that states will choose the strategy that is most likely to be successful in a given conflict. Thus, there is a concern that if we attempt to evaluate the effect of strategy on conflict outcomes, we may obtain biased results because strategy was chosen with its effect on outcomes in mind.

The aim of this chapter will be to argue for the relevance of studying the effect of aerial strategy on conflict outcomes. I will do this by arguing for two main points. The first will be that there is no such thing as an "ideal strategy" when it comes to aerial strategies. I will argue that it is not the case that there is some single ideal aerial strategy that all states strive for and attempt to implement. I will make this argument both by reiterating the strategy choice model I developed in the theory chapter of this dissertation and by making a general argument as to why targeted aerial attacks may not always be the most appropriate strategy for a conflict. The second main point of this chapter will be that it is not the case that states always use the "best" aerial strategy in a conflict. I will argue that states are often constrained by the structure of their military and their military doctrine and will thus follow a path-dependent approach to strategy selection. I will support this claim through an empirical analysis in which I show that states with similar

capabilities in similar targeting situations will often opt for different aerial strategies. I will discuss and compare individual cases (such as that of the Soviet intervention in Afghanistan and the Vietnam War) to support this point. This chapter will thus be devoted to showing that there is no one ideal aerial strategy, and that while in theory states may select the military strategy that is most likely to lead to victory, in practice their choices will tend to be constrained by their current military doctrine (which will take into account the institutional set-up of their military and the state's current view on war-fighting).

Ideal Strategies?

A key point that I will make in this chapter, and throughout the rest of this project, is that there is no single ideal strategy that is best for states to use in any sort of conflict that they might be involved in. In other words, I will make the argument that under some circumstances the modern system will be the most effective one, whereas in others the non-modern system will be more appropriate. In fact, it may be the case that a mixture of the strategies can be most effective rather a pure use of one.

In particular, because the modern system can serve as a force multiplier, some might believe that it is inherently superior to the non-modern system. This means that states that used the non-modern system would have done so either in error or because they lacked the capabilities to implement the modern system. I find this view to be overly simplistic, as well as being unable to explain cases of powerful states choosing to implement aspects of the non-modern system. Also, neither system (even while controlling for capabilities, etc) is a perfect predictor of campaign success. I thus argue

that the "best" strategy for a conflict will depend on the context it is being applied to, and may indeed be a mixture of strategies.

As I have previously reviewed how the modern system can serve as a force multiplier, I will also discuss how it can be a riskier system to use (thus making it inferior to the non-modern system in some situations).

The Risks of Using the Modern System

A major drawback of using the modern system is simply that it can be a riskier strategy to use. As Luttwak (2001)states, if one side is relying on the success of an operation that applies force to what is believed to be a key vulnerable point of the enemy's forces, the failure of that particular operation could lead to the collapse of all related operations that depended on that one success. Because the modern system can rely on getting a very large amount of moving parts to key places, any problem could easily result in chaos (S. Biddle 2004). The modern system relies on overwhelming a particular weak point and leading to the collapse of the enemy. The point of it is not to defeat the enemy as a whole. Thus, if (through misinformation, for example) that one key point is unexpectedly strong, the modern attack may fail. As Biddle states, the modern system is "complex and unforgiving" (Biddle 2004, 47), which means that if there is a lack of coordination, one's forces can end up exposed to the enemy's firepower, with lethal consequences. For example, in the case of modern defensive operations, coordinating the moving parts of deep reserves is much more difficult than having a static defense, and may even have an adverse effect on the morale of the troops, who may feel isolated and exposed (Biddle 2004). In contrast, under the non-modern system, missing a

single target will not jeopardize the entire operation, or place a disproportionately high number of troops at risk (Luttwak 2001). Under the non-modern system there is much less of a risk of a smaller force finding itself overwhelmed by the enemy, as in this case forces are rarely matched against much larger enemy ones.

One well-known example of an operation that relied on what could be referred to as a modern form of force employment would be the 1993 Battle of Mogadishu (often referred to as "Black Hawk Down," after Mark Bowden's book of the same name). The battle ensued after a raid by US Special Forces to capture a group of Somali leaders loyal to Somali warlord Mohamed Farrah Aidid (a group hostile to the United States) deteriorated into an unplanned urban confrontation with hostile Somalis. This was a raid that relied on the superior training of its troops (as compared to the Somalis) to get in, achieve their aim of capturing the warlords and evacuate before the confrontation could escalate (the entire operation was estimated to last no longer than thirty minutes). The operation was intended to be a low-cost one (politically and as far as the number of troops committed to it goes).

The problems began when the convoy that was supposed to extract the prisoners was slowed down by protests on the ground. The operation was further slowed down by an accident in which one of the rangers involved was injured after falling while fast-roping from one of the Black Hawk helicopters involved and had to be evacauted. Soon afterwards, two Black Hawk helicopters were shot down by Somali RPG's, stranding their crews at the crash sites. The Somalis then got a chance to overwhelm the superiorly trained, but vastly outnumbered Americans. The raid resulted in nineteen American soldiers killed and seventy-three wounded, with only one survivor being rescued from the

second crash site (Bowden 1999). What could have resulted in an easy, low-cost victory instead resulted in a large number of casualties and political costs to the Clinton administration. One can imagine that if the US had attempted the raid with a larger number of forces, in a less "modern" fashion, the high level of casualties could have been avoided.

Biddle (2004) also makes the point that engaging in limited aims attacks, while it may be thought of as less risky in the short-run (as there are likely to be less casualties as there would be from a full-out attack), may prove to be riskier in the long run. This is the case because limited-aims attacks usually do not destroy the opponents, but rather defeat them through the exploitation of a temporary advantage. This means that the opponent remains in the field, which could mean that they can recover and then come back to draw the other side into a much longer war with uncertain consequences. This means that states may be wary of reaching a settlement without winning an absolute victory. It can always be the case that as the balance of power changes in the future or the leadership of the opponent changes, the opponent will not stick to the settlement and may try to continue fighting in order to obtain a more favorable outcome (Reiter, How Wars End 2009).

Another issue with using the modern aerial system, which involves much more targeted attacks than the non-modern system, is that it requires states to effectively identify key targets that will have repercussions throughout the enemy's system. Mandel (2004) argues that one of the key difficulties involved in carrying out a targeted attack is simply indentifying what the key vulnerability points of the opponent are. This can be

particularly difficult when the target is a non-state actor (Mandel 2004)[25]. A greater amount of intelligence is needed if an attack is to be a more targeted one. The intelligence needs to provide information on what the key vulnerable point is, and where it is located (for example, even if the attacker knows that bombing the leadership of the opponent will cause repercussions throughout the system, it also needs to inform itself on where the leadership is located at the time that the attack is to be carried out). This again makes the coordination of the entire attack more difficult, bringing in another dimension that could lead to error and thus to negative outcomes. Non-modern aerial attacks also rely on destroying the chosen targets, but as they tend to be larger and more destructive, it will be less likely that a single attack will fail and negatively affect the outcome of the conflict. The intelligence needed for a modern attack not only has to contain information on where the target is located, but also on what the effect of the attack will be (Mandel 2004). An effective modern aerial attack needs appropriate intelligence on what the effect of bombing different targets will be, in order to choose the one that will have the greatest repercussion on the opponent's system. If the intelligence predicts that a targeted attack on a key point will have certain consequences but this turns out not to be the case, then the attack will not achieve its aims.

Another issue with using the modern system may be that these key vulnerable points may not actually exist for the target in question. The modern system relies on hitting key targets that will have repercussions throughout the system. The assumption then is that these points actually exist, but if they do not exist, or if the reperscussions are

[25] Note that while Mandel (2004) makes the point that carrying out a targeted attack against a non-state actor because of the challenges involved in identifying their key weak points, carrying out a non-targeted aerial attack against a non-state actor can also be difficult. For example, the option of bombing the opponent's major cities is not available if the opponent is not a state (e.g. if the target is a terrorist group with no identified homeland).

actually minimal, then the best option for the attacker will be to use the non-modern system. Mandel (2004) argues that this is more likely to be the case with non-state actors, but we could also identify cases of states in which it is difficult to identify a particular target that will have repercussions throughout the entire system if hit.

Testing the Theory?

The common implication from the model presented in Chapter 3 and the hypotheses derived from it is that there are specific circumstances in which the modern system is more likely to be chosen by states. These hypotheses predict the circumstances under which states are most likely to select either a modern or a non-modern military strategy. One way to address the problem of endogeneity would be to use these hypotheses to build an empirical model of strategy choice. The problem with trying to build and test a model of strategy choice empirically is that most of these independent variables that would predict strategy choice would be extremely difficult to operationalize. For example, hypothesis A states that attackers will be more likely to use the modern system as the probability of victory from using the modern system increases relative to the probability of victory from using the non-modern system. This means that in order to test this hypothesis we would have to derive a measure of both of these probabilities. The problem is that this gets back at the research question of this project, which is seeks to understand the circumstances under which each strategy would be most effective. This means that having a hypothesis that tells us that states use the modern system when it is most effective, without actually knowing when it is most effective, will not do much good.

The main question to answer, then, is when military strategies, in this case the modern and non-modern systems of air power, will be the most effective. Note that I am not making the argument that the modern system is a dominant strategy for states deciding how to employ their air power. As demonstrated by the model I derive in the theory chapter of this dissertation, there are times when choosing the modern system will not be in the best interest of the state that is using air power. As stated before, when it comes to air power, the greatest difference between the modern and non-modern system is how targeted the attack is. Modern-style air power relies on hitting targets that will be expected to have disproportionately high repercussions on other aspects of the opponent's military functionality (whereas non-modern air power relies more on destroying the opponent's capacity to continue fighting). The modern system will be dependent on two factors: the existence of such targets that can have a disproportionate effect on the enemy's ability to function and on being able to identify these targets (Mandel 2004). I will argue that these two factors are not always present, and that when they are not then it is in the best interest of the state to use the non-modern system. In different situations there will be different ideal strategies.

Of course, as stated in the introduction to this chapter, if this previous statement is true, the problem that we run into is that it becomes impossible to evaluate the effectiveness of aerial strategies, as there will be a large selection bias. This would be the case because we should expect states to in every situation use the strategy that is best suited for that particular conflict, which would mean that any evaluations of the effectiveness of the strategy would be biased. The argument that I will make in this

chapter, though, will be that states will often be constrained in their strategy choice. Thus, we will be able to observe what the effect of military strategies is on outcome, as this choice is not always dependent on the conflict a state is about to fight.

Seeing as conflicts often have one side that is victorious and one that is not, we know that states will often apply a particular style of fighting and this will not result in a victory. Now, we can argue that states could have suffered an even worse defeat if they had applied a different strategy, but more often than not, states' choice of military strategy is constrained by their capabilities and the training of their troops[26]. In other words, it is not always the case that states maximize their ability to win. We will often observe states using non-optimal styles of fighting.

As stated, part of this may stem from the fact that states are constrained by their capabilities and the training of their troops before the conflict began. Also, it may be the case that states do not know enough about their opponent before the conflict begins to be able to choose the optimal military-strategy response against their opponent. As the duration of these conflicts is generally short (the mean value of campaign duration is only 16 months, including long campaigns such as those from WWII (Allen 2007)), there is often not enough time for states to adapt their strategy to that of their opponent during the actual conflict.

States may not always use "the best possible system" (I am referring to the best possible system for that particular conflict, as I argue that there is no one-size-fits-all strategy that is optimal for every conflict) to fight a conflict because this option is not

[26] States are sometimes able to adjust the training of their troops during a conflict, and thus change their military strategy. The Russians appear to have done so during their intervention in Afghanistan. Their close-air support began as strongly non-modern, but as the conflict (which was an atypically lengthy one) progressed, the Russians adjusted their close air support style to a modern one that proved to be more effective against the Afghans.

available to them. In the remainder of this chapter I show this is by finding examples of states that are equal as far as capabilities go, but where only one of them uses the modern system.

A Test of Strategy Choice

The concern with studying the effect of military strategies on conflict outcomes is that states may choose the best military strategy to fight a particular opponent. Thus, any conclusions that we draw about the effectiveness of a particular military strategy cannot be generalized, as the strategy was chosen with that particular conflict in mind and was chosen to be effective in that context. Thus, in a different context the same strategy might not be effective.

If this were indeed to be the case, then the implicit assumption would be that there is a "best" strategy to use in a given conflict (or at least that some strategies will work better than others). Thus, when similar states find themselves in the same types of situations, we should expect them to choose the same types of strategies, the "best-response" strategies. What I will show in this section is that similar states will find themselves in the same types of conflicts (facing similar opponents) and will still opt to use different strategies.

The analysis that follows uses the characteristics of the opponent to attempt to predict the aerial strategy that the attacker will use. The idea behind it is that if states really do choose the best possible strategy for a conflict, then the characteristics of the opponent should be a good predictor of strategy choice. States (especially states with

roughly similar capabilities) should always use the best strategy available for the particular conflict they are fighting in.

The dependent variable in this analysis will be the choice of aerial strategy by the attacker. This means that I will be using the newly coded data on aerial strategies as my dependent variable. The data were collected as a series of questions that determine how "modern" (or "non-modern") a particular use of air power is. The questions will be aggregated into a single measure of modern proportion by adding a point for every question that was answered in the affirmative in the coding process. I use only data for the dominant type (or types) of air power (CAS, interdiction or strategic attack) that was used by the state in that particular conflict[27]. In order to be able to compare across different uses of air power, I create a measure of modern air power that measures the proportion of the total amount of air power used that is modern. For the analysis I convert this continuous variable into a dichotomous one, in which states that have more than .50 of their aerial strategy as modern are coded as modern and states which have an aerial strategy value of less than .50 are coded as non-modern.

For my independent variables, I will begin by including the widely-used Composite Index of National Capability (CINC) for the attacker (Singer, Bremer and Stuckey 1972). I include this measure because one of the points that Biddle (2004) makes about the modern system is that it can be a demanding system to implement, requiring extensive training of troops and coordination with intelligence. One could argue that this is something that is easier to execute for states that have greater material

[27] These categories are not mutually exclusive, meaning that a given air campaign can include one, two or all three forms of air power.

capabilities, so that it is important to control for the capabilities of the attacker when predicting strategy choice.

Beyond the capabilities of the states carrying out the attack, the characteristics of the opponent should also determine the aerial strategy that a state uses, at least to a certain degree, if states always use the best possible strategy against an opponent. Thus, for example, when states were fighting industrialized opponents that were stronger than them and that they had been involved in a rivalry with for many years, they should follow the best strategy for that option. Or, there should be an ideal way to fight less-powerful non-state actors. Thus, I will include in my analysis a variety of independent variables that represent the characteristics of the target state.

One independent variable included in the analysis will be a measure of the difference in power between the attacker and its target. This is operationalized as the ratio between the CINC score of the attacker and the CINC score of the target, with less-than-one values indicating cases in which the attacker is weaker than the target (Singer, Bremer and Stuckey 1972). The reasoning behind including this variable is that the way in which a state fights an opponent that is much weaker than it will be different from the way in which it fights an opponent that is its equal, or even stronger than it. For example, a state that is fighting a much weaker opponent might choose more targeted attacks to avoid civilian casualties, while if it were fighting an opponent that was stronger than it then it might choose to actually choose to hit civilian targets in order to attempt to turn the population against its government (in place of actually having to defeat the military of its opponent).

Another indicator of the type of target that the attacker may be facing is whether the opponent is also using air power. The aerial strategy that states would use against an opponent that is also using air power should be expected to be different from that which they would use against an opponent that did not have aerial capabilities. We would expect that the aerial strategy of a state that was facing an opponent that also had aerial capabilities would have to take into account the defense of its own aircraft (or other key targets) from aerial attacks from the enemy. Thus, this should determine the aerial strategy that a state used against its opponent. One possibility is that states will be more likely to use modern aerial strategies against opponents that are using air power, as part of the air defense plan may involve destroying the opponent's aircraft through a targeted attack.

It also may be the case that states will fight differently against those that they have engaged before than they would against a new opponent. If states have a history of being involved in conflict with a particular target, they may be more likely to attempt to cause absolute destruction in the target state, perhaps to prevent it from attempting to challenge the attacker again in the future. I will thus include in the analysis a binary variable that states whether the attacker is involved in a rivalry with the target in that given year (Bennett 1998).

Though the modern system of air power is not exclusive to any particular technology, it is true that the development of precision-guided munitions (PGM's) have made the use of more targeted aerial attacks easier. Thus, I will include a control variable

that will tell us whether the observation took place before or after 1950[28], to control for more common uses of the modern system as time progresses.

Given that the dependent variable has been transformed into a dichotomous one, I will use a probit analysis to test the effect of the target's characteristics on the choice of aerial strategy. The main operational hypothesis will thus be the following:

Hypothesis 1.1: A state's likelihood of using the modern system of air power will be independent of the target's characteristics

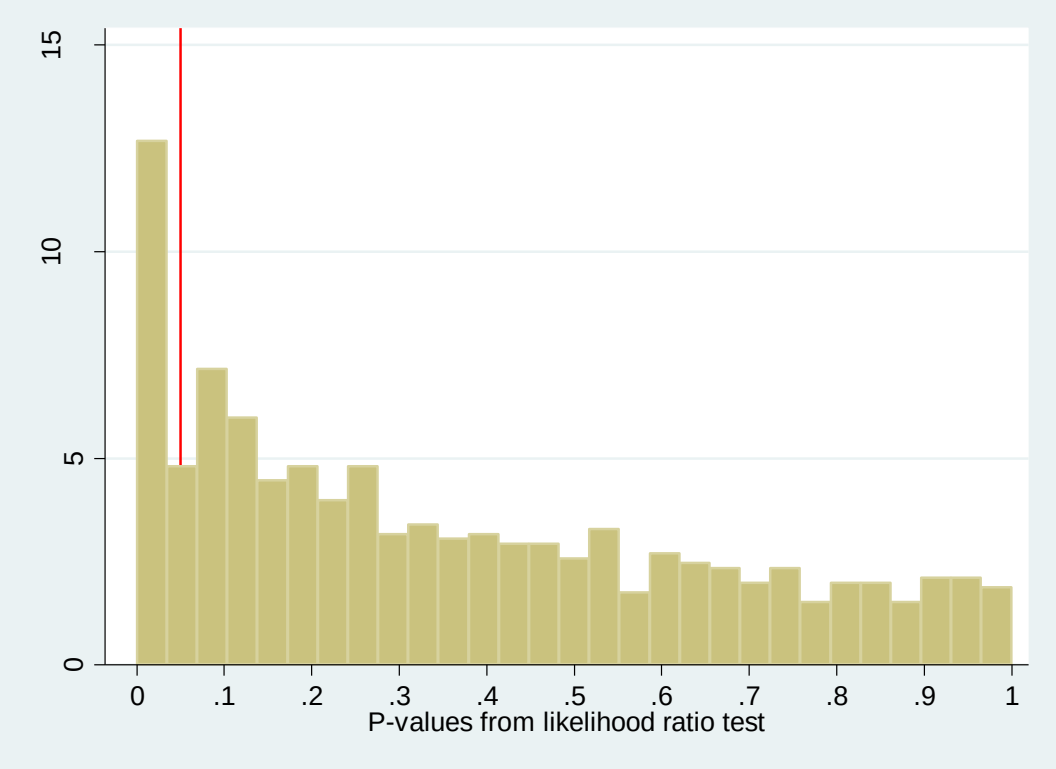
Testing this particular hypothesis is difficult because I am essentially relying on a null finding to support my hypothesis. It is also problematic that the sample size is small (since we are only considering conflicts in which air power was used). I address the issue of the small sample size by using a bootstrap procedure with 1000 bootstrap estimates. I also create two models, one that includes the characteristics of the target state as well as the attacker's CINC score and the post-1950 variable as control variables, and a null model that simply contains the control variables. After bootstrapping both models, I then run a likelihood ratio test to compare the fit of the two models. I compute the p-values to decide whether we can reject the null model.

I choose a standard significance level of 0.05 (which is marked as the vertical line in the graph) as a guideline that will determine whether the null model can be rejected. In other words, to determine whether adding the variables for the characteristics of the

[28] The year 1950 is a somewhat arbitrary marker. PGM's were beginning to be developed during World War II, such that they were not widely used until after that. Using cut-off dates of plus or minus five years does not make a difference in the results of the analysis.

opponent adds much to a simple model that simply includes a post-1950 variable and a variable that represents the CINC score of the attacker.

Figure 5.1: P-values Derived from Likelihood Ratio Test, Comparing Null Model and Model Including Opponent Characteristics (Power Ratio as Measure of Relative Capabilities)

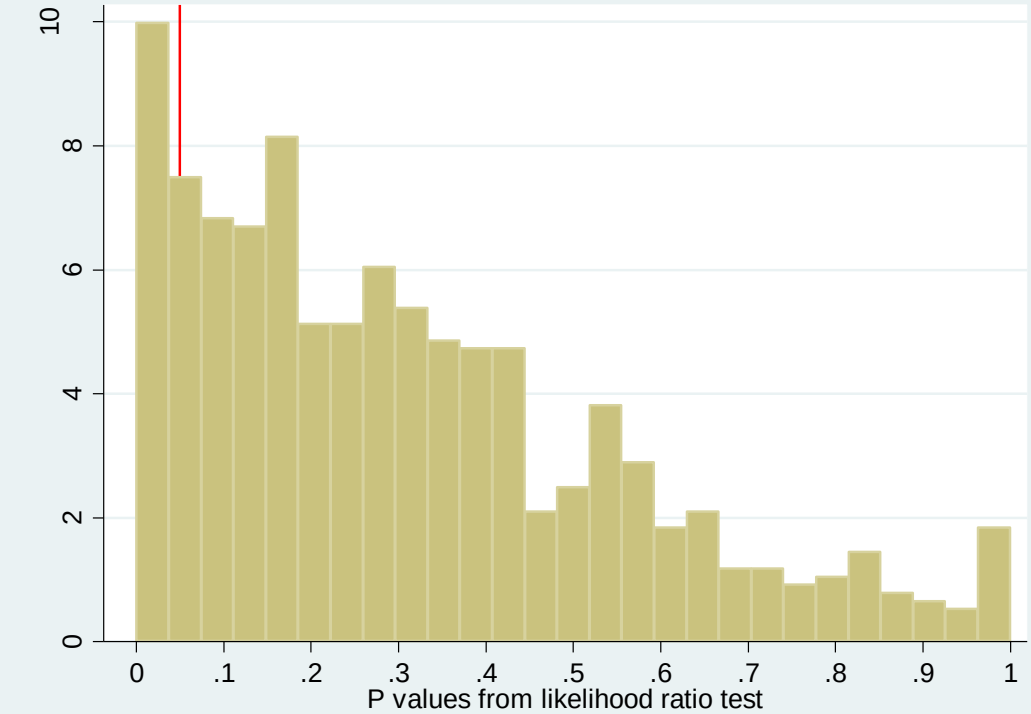


As we can see from Figure 5.1, 85% of the p values from the likelihood ratio tests (on each of the bootstrap estimates) are values that are greater than 0.05[29]. This means that in 85% of our simulations, we are unable to reject the null model (the model with only the control variables included). Thus, it tells us that in 85% of our cases adding variables about the characteristics of the target does not add a significant predictive value to our model.

[29] I use a p-value of 0.05 as the standard because in recent empirical IR literature it is common to use a standard of a .95 level of significance to determine statistical significance.

We can also measure the capabilities of the attacker using GDP per capita. Because this is an absolute measure, it may be a better way to get at the concept of how capabilities make it possible for states to implement the modern system than the CINC score (which is a relative measure). I thus substitute the CINC score with a measure of GDP per capita as a control variable by the model[30]. Below I present a similar graph that presents the p-values of the likelihood ratio tests on each of the bootstrap estimates, using GDP per capita as a control variable.

Figure 5.2: P-values Derived from Likelihood Ratio Test, Comparing Null Model and Model Including Opponent Characteristics (GDP as Measure of Capabilities)



As we can see from this graph, measuring capabilities of the attacker through GDP does not alter the results much. 86% of the p-values are still greater than 0.05,

[30] I use Gleditsch's (2002) expanded trade data to measure GDP. Because the data only begin in 1950, I use 1950 values as an approximation of pre-1950 values in observations that occur before 1950.

showing that the addition of the target characteristic variables does not add much to the predictive power of the model.

We can also look at some simple two-way correlations between the dependent variable and the characteristics of the target and see that the correlations between the use of the modern system and the characteristics of the target are somewhat weak.

Table 5.1: Correlation Between the Use of Modern Air Power and Target Characteristics

	Power Ratio	**Rivalry Presence**	**Target use of Air Power**
Use of the Modern System	0.22	-0.02	-0.37

The only independent variable that seems to be more strongly correlated to the use of the modern system is whether the target used air power. The variable is also negatively correlated, meaning that we would expect states to be less likely to use the modern system in cases in which the opponent is also using air power. This result may simply be a function of the small sample size, and be driven by the fact that out of the cases in which a non-modern system was used against an opponent that was utilizing air power, a large proportion of them are World War II cases. Because these are all pre-1950 cases, when carrying out targeted attacks was much more challenging and less of a choice for various states, this correlation may have more to do with the availability of the modern system than with the strategy being determined by the characteristics of the opponent. World War II is also somewhat of an anomaly in that it was mostly being fought by major powers, all of which possessed air capabilities. Thus, it seems that this relationship is mostly driven by the fact that major powers were fighting other major

powers in World War II, but the use of the modern system was not as prevalent then as it would be in the future.

While trying to draw conclusions from a null finding can be problematic, this analysis certainly seems to imply that states are not always able to select the military strategy that is best suited for fighting a particular opponent. To further support this argument, I will argue, in the section that follows, that this is the case because states are already constrained in their choice of strategy by their military doctrine and the institutional set-up of their military. I will then look comparatively at the cases of the Soviet Union in Afghanistan and the United States in Vietnam, to illustrate how states' aerial strategy follows more closely from their doctrine than it does from the characteristics of their opponents.

Military Doctrine

Earlier in this dissertation I discussed how one major drawback of the modern system is that it can be prohibitively difficult to implement for some states. As Luttwak (2001) argues, effectively implementing the modern system places great demands on the military personnel tasked with doing so. This means that only high-quality, extensively trained units can be used to effectively carry out a modern strategy. This means that a state cannot simply make the decision to use the modern system at the beginning of the conflict. It cannot do so because if its troops are not already trained to implement the modern system, they will not be able to execute it effectively.

Because military training, particularly training that enables troops to implement the modern system, takes time, states must train their troops to be able to implement the modern system before a conflict even begins. Also, this training, because it is more

extensive and requires higher-quality personnel, is costly for the state that is carrying it out. The costs of implementing the modern system also go beyond training the actual troops. As Mandel (2004) argues, successfully implementing the modern system also requires extensive intelligence. This means that a state that is planning to implement the modern system will also have to invest a considerable amount of its resources on developing a extensive intelligence structure that can provide it with the information on what the opponent's key vulnerable points are, and how they can be located.

Thus, we can argue that for some states it will be best to choose not to choose to implement the modern system. This choice can be a rational one if they believe the potential gains from using the modern system in conflict will not outweigh the costs of changing their doctrine, training their troops to be able to implement the modern system, and setting up an intelligence-gathering structure to support the implementation of the modern system of air power. This is particularly true once states take into account the potential risk involved in using the modern system.[31]

When it comes to implementing the non-modern system, because it is true that it is less challenging to implement, it might seem to be the case that it would always be available to states that are able to implement the modern system (Luttwak 2001, Mandel 2004). While this might be true in theory, it may be the case that certain aspects of the non-modern system are not palatable to the population of the state which is considering it, thus making it unavailable to them. For example, fire-bombing civilian centers would fall under the category of non-modern. For some states, whose military doctrines emphasize minimizing civilian casualties, using this strategy would not be a realistic

[31] As discussed earlier, modern uses of air power rely on coordination and causing temporary disruption in the opponent's operations. Minor mistakes can cause the entire operation to fail, leading to worse outcomes for the attacker than if they had used the non-modern system.

option under most circumstance. Thus, even if it were the best strategy to use in a particular situation, political and military leaders would feel constrained against using it.

I thus argue that states will fight according to their military doctrines. A military doctrine can be very difficult to change both because it involves retraining troops and the restructuring of the military establishment. It is almost never in the best interest of a state to deviate from its military doctrine right before beginning a conflict. Troops go through extensive training so that they will be able to function effectively and implement that training once they find themselves in conflict. This means that we should expect that states will stick by their doctrine when fighting in a conflict.

Because a military doctrine is long-lasting, it will very rarely be chosen to fit a particular conflict that a state engages in. Rather, states choose their military doctrine not knowing what their future conflicts will be, or what their future opponents will be. Military doctrine is in fact often determined by factors that go beyond the characterisitcs of even potential opponents. While we may assume that military doctrines are formed with potential adversaries in mind, it may be the case that domestic factors have a stronger influence on them than we would imagine. For example, Pilster and Bohmelt (2011) make the argument that military doctrine is often greatly determined by internal threats, with states often setting up their military doctrine to coup-proof the state, even at the expense of military effectiveness.

This means that, at least in theory, the choice of military strategy will be exogenous to the conflict that the state is engaged in. It will then be possible to derive conclusions about what the effect of military strategy (in particular, aerial strategy) will be on conflict outcomes.

The Case of the USSR in Afghanistan and the US in Vietnam

Because it is difficult to test a model of strategy choice empirically (because of the difficulties involved in coding what the military doctrines of states are), I will instead choose to do a case analysis of two similar states, fighting similar opponents, that used different aerial strategies, in accordance with their military doctrines. If states really did use the best strategies for every conflict, we should observe two different states with roughly similar capabilities, in similar situations, using the same strategy in the air. In particular, I will look at the case of US vs. Vietnam 1972 (Linebacker I and II) and the Soviet Union vs. Afghanistan during the Soviet-Afghan War. In both of these cases we are observing a major power (the two largest major powers at the time of the Cold War) fighting a less powerful opponent (the North Vietnamese and Afghanistan, respectively) in the opponent's homeland. If strategy choice really were to be determined by the conflict, their strategies should be extremely similar.

In the Vietnam War, Operation Freedom Train (which was renamed Linebacker in April of 1972) began in February of 1972 and marked the renewal of major air strikes by the United States for the first time since 1968. This operation was a response to the North Vietnamese invasion of South Vietnam, the Easter Offensive. Linebacker I involved bombing a very wide range of targets, including roads, warehouses, bridges, industrial facilities, vehicles, power plants and shipyards (and many of these targets were targets of opportunity). Still, there did seem to be a focus on cutting the lines of communication of the North Vietnamese army and destroying their transportation resources. Using both precision instruments and visual strikes, the American forces

aimed to destroy targets such as bridges and roads that would weaken the North Vietnamese by isolating them from their supply lines. In particular, the Thanh Hoa Bridge (which the Americans had failed to destroy under Operation Rolling Thunder) was destroyed through the use of guided bombs. These were all attacks on targets that were not intrinsically valuable, but that were significant because they were expected to have a disproportionately large effect on the effectiveness of the opponent. In other words, the attacks of Linebacker I could be considered to fall under the category of modern uses of air power (GlobalSecurity.org).

During Linebacker II, the U.S. objective was to force the North Vietnamese government to enter into negotiations on a cease-fire agreement. A wide range of targets was included in Linebacker II, which meant that it had elements of both the modern and the non-modern system of air power. While Linebacker included attacks on targets such as army barracks, which would not be considered modern, there was also a continuation of attacks on railroads and highways (which were expected to cut off the North Vietnamese troops from their supply lines). Linebacker II also included strategic attacks on targets such as petroleum storage areas. Thus, while both Linebacker I and II included elements of both the modern and non-modern systems, in the aggregate there seems to be a modern tendency to the way the U.S. conducted its air campaign (GlobalSecurity.org).

From 1979 to 1988, the Soviet Union was involved in its Afghan War, which is often compared to the US involvement in Vietnam. Despite the large number of aircraft commanded by the Soviets, the air arm remained subordinate to the ground forces throughout most of the conflict. Most fixed-wing aircraft was used for strategic bombing. The Soviet strategy for strategic bombing involved carpet-bombing the Afghan

targets. The aim of the strategic bombing was the destruction of Afghan society, which meant that targets included actual villages or agricultural targets that were the Afghans' sources of food production. Civilian casualties were high, and expected to be so. This type of attack, which focuses on destroying the enemy rather than impairing its ability to fight, would fall under the non-modern category of air power.

The Soviet attacks on military targets did have an element of the modern system to them, particularly the close-air support. Jets would use deceptive techniques by working in pairs, one of them being used for distraction. Helicopters would rely on surprise and reducing the reaction time allowed to the Afghan rebels. A few of the jet pilots were given the opportunity to act more independently and attack targets of opportunity in the rear of enemy positions, but in general attacks tended to be coordinated from the top. The bombing of SAM sites showed a lack of pilot initiative, as they were bound by the textbook approach to this sort of attack and rarely deviated from their flight plan. This often resulted in them being unable to hit the key points that would have crippled the Afghan forces the most (McMichael 1991).

Soviet doctrine at the time emphasized the principle of annihilation of the enemy. It stressed the importance of destroying the opponent's forces, not simply leading them to retreat. Aviation was viewed as being unified with ground forces, and not expected to operate independently. Beyond the air force being tied to the ground forces, the troops themselves were trained in a relatively inflexible manner, being expected to be able to executive specific and detailed orders. The stressing of destruction of the opponent's forces over disruption, along with the lack of independence between arms of the military and across levels of authority, would be more in line with the non-modern system of

strategy. Much of the emphasis of the Soviet doctrine was on choosing the space and time of the battlefield. In other words, on being able to decide when and where the battles would be fought, in order to choose the most advantageous position for the Soviet forces. Because in Afghanistan this option was often not open to the Soviets, they were unable to adapt their strategy to the situation. Of course, as demonstrated by the score of modern air power use by the Soviets in this situation, the Soviet doctrine did have some elements of the modern system included in it. For example, the Soviet doctrine emphasized the inclusion of intelligence-gathering personnel as combatants. As discussed before, the gathering of intelligence is key to being able to successfully implement the modern system.

US aerial doctrine at the time of the start of the Vietnam war was geared towards fighting a powerful, industrialized state. It emphasized targeting vital production facilities through strategic bombing to impair the war-fighting capabilities of the opponent (Hamilton 1993). This was of course a problem for the United States when they entered a conflict with the less industrialized Vietnam (and probably explains the lack of success the US experienced at the beginning of the conflict). At the same time, though the United States did adjust to the situation, their actions weren't necessarily contradictory to the doctrine. If we look at the cases of Linebacker I and Linebacker II, we can see that the U.S. was attempting to bomb the targets that would halt the supply of goods to the North Vietnamese army. Seeing as North Vietnam was not an industrialized state, the analogous action was to target the other sources of supplies for the North Vietnamese, which in this case meant targeting their lines of supply. The bombing campaigns in North Vietnam tended to remain somewhat limited, in accordance with the

modern system, which stresses the attacking of key targets instead of the total annihilation of the opponent.

At the time, the CINC scores were .163286 for the US and .168808 for the Soviet Union (some of the closest ones in the sample). Neither attacker was considered to be involved in a rivalry with its target. They were both significantly stronger than their opponent, and the difference between the attacker's and the target's CINC score was .157 for the US and .167 for the Soviet Union (again, these are extremely similar). Their military expenditures to military personnel ratios were also not too different from each other (33,421 for the US and 46,153 for the USSR).

This means that under the assumption of endogenous strategy choice, we should expect the two states to use similar forms of air power. Yet the value for the percentage of air power that is modern is .76 for the US and only .50 for the Soviet Union (the mean value for the modern air variable is .47, with a .20 standard deviation).

What is helpful about these results is that they also tell us that it does make sense to study the effects of military strategy on conflict outcomes. The fact is that these two states (the US and USSR) looked very similar as far as their capabilities go, and also found themselves in very similar situations. After all, they were both fighting an ideologically-motivated war (one fighting against Communists, the other supporting Communists) in a less-powerful country. They were both fighting away from their homeland and facing an opponent that often fought in guerrilla style. If there really were some sort of dominant aerial strategy (for each particular type of conflict) that states would default to if they were capable of it, then both the Soviet Union and the United States should have used the same military strategy in both conflicts.

This case also addresses the concern that states will always choose the military strategy that is more likely to lead to a victorious outcome. In this case, we have two very similar states (at least as far as military capabilities go) fighting similar opponents. Yet they used different aerial strategies. Clearly one of them should have been more effective in that particular situation, yet the two countries chose very different strategies. This shows that states will not always choose "the most effective strategy" when fighting. They may choose the one that they believe to be most effective, but this will not also be perfectly correlated with outcomes. Also, as looking at these cases in more detail shows, states are often constrained not only by their capabilities, but also by their military doctrine and the way their troops are trained to fight.

The Soviet case in particular is a good illustration of how states can be constrained in their strategy choices when initially entering a conflict. In this case the aerial strategy of the Soviets shifted towards a more modern one (in particular in their use of close air support as the conflict progressed). Because this conflict is one of the longest ones included in the data (almost 10 years), there is time for the state to change its strategy. Most states, though, will be constrained by their military force structure and doctrine when they enter the conflict. That means that the military strategy chosen will not always be the "optimal" one (for that type of conflict), but the one that is available to the attacker. This will address the problem of whether states always simply choose the best strategy for that conflict.

CHAPTER 6: AIR CAMPAIGN DURATION AND THE INTERACTION OF AIR AND GROUND STRATEGIES

The previous chapter, Chapter 5 of this dissertation, dealt with how states choose an aerial strategy. It made the point that states will not always choose a military strategy based only on the particular conflict that they are about to engage in. Rather, states' aerial strategy choices are likely constrained by their military doctrines, which have been selected earlier, and often driven by domestic concerns as well as foreign ones (Pilster and Bohmelt 2011, T. D. Biddle 2002). This means that it will be possible to evaluate the effect of using different aerial strategies on a number of conflict outcomes.

As mentioned before, much of the earlier work on aerial strategies has focused on air power somewhat independently of forces on the ground. Though a few works, such as that of Horowitz and Reiter (2001), do include in their analysis a variable that measures whether there were ground troops present during the duration of an aerial bombing campaign, there is still much room to determine how the different *types* of strategies on the ground can influence the effect that bombing campaigns have on the outcome of a conflict. Most aerial bombing campaigns will be accompanied by some form of ground attack (and the ones that aren't can be thought of as cases in which the choice of ground strategy is simply having no ground troops), which means that considering how bombing campaigns affect outcomes without taking into account the nature of the ground invasion may be strongly biasing results. This chapter will study what forms of ground strategy will lead to a more effective use of the modern system in the air.

Modeling the Interaction of Air and Ground Power

The model developed in the theory chapter begins by explaining the aerial strategy choices of different states. The assumption it makes is that states' strategy choices will be based on the expected effect of a strategy on conflict outcomes. This means that the next question to explore is what the effect of aerial strategies will be on conflict outcomes. In past work, the effect of ground strategies on conflict outcomes has been extensively studied, as has the effect of bombing either civilian or military targets. As was mentioned before, though, the success of an air campaign will depend strongly on what is happening on the ground. This means that there is much room to explore what the effect of aerial strategies is on conflict outcomes, taking into account what is happening on the ground.

In determining how the effectiveness of the modern system will depend on the strategy on the ground, it is important to think about what makes the modern system more likely to be successful.

In the theory chapter I derived the following hypothesis:

Hypothesis D: If the mean values of both strategy systems are the same, as the difference in variance of outcomes between the modern and the non-modern system increases, states will be less likely to use the modern system.

This hypothesis assumes that states are not risk acceptant, implies that the modern system of air power will provide greater utility to states when the variance in outcomes

between the modern and non-modern systems is smaller. We can imagine that the strategy that is being used on the ground may help to decrease this variance.

When discussing variance in outcomes, we can think that there are different types of victories (and by extension different types of defeats). When we say that a state's campaign was victorious, we mean that the state was able to achieve its aims, but we could be referring to the case of a close victory (in which the state was at a high risk of being defeated) or an overwhelming victory in which it was very clear that one side was superior to the other and it was able to achieve its aims easily. Another way to think about the variance in outcomes is to think about states that use a particular type of strategy (for example, modern air power) will have more variance in their propensity to be victorious in conflict. The problem with trying to measure the variance in outcomes is that the data on campaign outcomes is measured dichotomously, which means that in order to differentiate between different types of victories we would have to devise a separate measure that indicates the degree of victory or defeat[32]. This would of course entail a separate, and time consuming, data collection effort.

An alternate way to think of the effect of ground troop presence on aerial power strategies will be to study the duration of aerial campaigns instead of their outcomes. While the ultimate aim of this project will be to understand how different air and ground strategies can affect the outcome of aerial campaigns, their duration provides an intermediate characteristic that allows us to understand how strategies will affect the characteristics of aerial strategies. Duration can be understood to represent different

[32] One possibility would be to address this problem by using the heteroskedastic probit model, which can measure variance in cases in which outcomes are dichotomous. One potential problem with this approach, though, is that the small size of the sample that will be used in this study will place to large of strain on the data.

types of outcomes. In the case of success, it should be the case that those campaigns that are the shortest should be the most overwhelming victories (because it is quickly resolved that one side is stronger than the other and the conflict ends). For example, when Germany carried out a bombing campaign against Poland in 1939 as part of its plan for a Polish invasion, the bombing campaign lasted for only one day. As the German tanks, infantry and cavalry penetrated Poland through several fronts, the Luftwaffe bombarded Polish cities (including Warsaw) with incendiary bombs. By starting hostilities without a declaration of war and emphasizing the rapid movement of troops, Germany was able to surprise Poland. Despite efforts by the Polish military (including the Polish Air Force) to fight the Germans back, Poland was overwhelmingly defeated by Germany. In other words, the duration of a campaign can be used as an indicator of the degree of victory or defeat.

Of course, if one side achieves victory very quickly, it means that its opponent was defeated quickly. Thus, short campaigns that ended in defeat should represent those cases in which one side was overwhelmingly defeated by the other, or in which it became obvious early on that it was not going to be able to achieve its goals through the aerial campaign. For example, in the case of 1986's Operation El Dorado Canyon, in which the United States retaliated against Libya for the bombing of a discotheque in West Berlin that was frequented by American service members, the bombing campaign lasted only a few hours. Despite the aircraft hitting most of its intended targets, the campaign is coded as a defeat for the United States (Allen 2007).This is because through the bombing raid the United States was unable to achieve its goals of either killing Gaddafi (Gaddafi was not in the expected location that U.S. intelligence had place him at) or reducing Libyan

terrorist activity. Rather, there was a large international reaction against the U.S. bombing Libya in a situation in which there was no imminent threat against the U.S. Thus, the United States quickly realized that this bombing strategy was unlikely to help it achieve its aims and did not extend the duration of its bombing campaign over Libya.

I will also make the argument that longer aerial campaigns will signal cases in which there was more uncertainty over which opponent would achieve victory, and thus had to be continued until supremacy could be established by one side or the other. I am assuming that if a state had to continue an aerial campaign for a long period of time, it is because it was more difficult for it to achieve victory. Thus, cases that are coded as successes and have a long duration will likely refer to those victories that were more difficult for the attacker, as both sides were more evenly matched in the conflict. The same applies to defeats that came after a long aerial campaign. These will be the cases in which it was not immediately obvious to one side that it would lose the campaign, and thus it continued to fight. One example of such a campaign is that of the Iran-Iraq War, which is coded as having lasted for 93 months. This is a case in which both sides were somewhat evenly matched, and both sides incurred enough casualties and costs to prevent us from saying that either one was able to achieve an overwhelming and clear victory over the other.

Longer campaigns will thus represent the cases that are neither overwhelming victories nor overwhelming defeats (and we think of victory or defeat as being defined by whether the state we are considering was able to achieve its aims through the campaign), or even cases or draws. Thus, longer campaigns will represent a smaller variance in potential outcomes. Shorter campaigns will represent a greater variance, covering cases

in which victory was achieved quickly by one side, which means also that the opponent chose to stop fighting (by being incapacitated or realizing it was not going to achieve its aims) quickly.

Table 6.1: Duration of Victories and Defeats

Outcome	Duration	Description	Example(s)
Victory	Short	Overwhelming victory	Germany vs. Poland (1939)
	Long	Close victory or draw	United States vs. North Korea (Korean War)
Defeat	Short	Overwhelming defeat, quick evidence of erroneous strategy	Operation El Dorado Canyon (American aims not achieved)
	Long	Close defeat or draw	Iran-Iraq War (draw)

Given this set-up, I will further argue that ground troops will contribute to shorter durations of aerial campaigns. I will argue this to be the case because ground troops are able to correct for mistakes and aid the air campaign in being able to locate key targets. Without ground troops, and the intelligence they provide, present, it will take a longer time (more trial and error) to achieve a victory. This should be particularly true in the case of the use of the modern system of air power, which relies strongly on the correct intelligence on the ground to identify key targets, and for which the presence of ground troops will be particularly useful to correct for mistakes.

Further, one of the main arguments for the use of combined arms (in this case, air and ground troops) is that it leads to an increased effectiveness when fighting the opponent (which for this situation would mean that victory could be achieved quickly). When an opponent faces a combination of ground and air forces, that opponent must simultaneously react to both. That means that while a certain strategy (dispersing tanks so that they cannot easily be bombed from the air, for example) may be the most effective

one for fighting an opponent that is attacking from the air, that same strategy will not be the most effective one against an opponent from the ground (in this case, the dispersed tanks would be more vulnerable to ground forces than if they were clustered together defensively). While this argument refers specifically to swift victories, it fits in with the general framework of this paper.

The Presence of Ground Troops

Before considering the effect of different strategies on the ground on the duration of air power, the first question to consider is simply whether ground troops are present at all. Previous work has found that aerial bombing in general is more effective in cases in which there are troops on the ground (Horowitz and Reiter 2001). The question to develop in the chapter will then be to see how the presence of ground troops will affect the duration of aerial campaigns, depending on the different types of aerial strategies that are being used.

Cases in which aerial bombing is conducted without any ground forces are rare, but when they are conducted effectively they can provide states with a "clean" and politically low-cost victory. One example of such a case is NATO's bombing campaign in Kosovo. In 1999 NATO intervened to stop the killing of ethnic Albanians by Serbian leader Slobodan Milosevic. Possibly concerned about negative domestic responses to the commitment of ground troops (and the possibility of casualties), NATO intervened solely through an air campaign that targeted government buildings, factories, and infrastructure, focusing on hitting those targets that were most important to Milosevic himself (Simos and Smale 2006). The air campaign was successful, resulting in the withdrawal of Serbian forces from Kosovo, without a need for a ground campaign and

the commitment of NATO ground troops. This means that the NATO states were able to achieve their aim while minimizing their own costs[33].

Another example of an air-only campaign would be the most recent use of air power by NATO in Libya in 2011. The revolution that began in Libya in August of 2011 was carried out by local militias that were opposed to Muammar el-Qaddafi. While many governments favored the toppling of the Qaddafi regime, there was reluctance in the international community (particularly in the case of the United States, which was already involved in two wars abroad) to involve foreign troops in the Libya conflict. As the Qaddafi's repression of the opposition grew, the U.N. approved the creation of a no-fly zone in Libya. This no-fly zone was to be a way to prevent aerial attacks by Qaddafi's forces on the opposition. NATO took responsibility for enforcing the no-fly zone, and also provided air support for the rebel forces. By October of 2011, only months after the beginning of the air campaign, Qaddafi was dead and his regime toppled, all without the commitment of any NATO ground units.

From observing these two cases it would seem to be the case that it should be in states' best interests to always use aerial campaigns without committing ground forces. After all, the air campaigns allow states to achieve their desired outcomes without having to place their troops at risk and incurring both the financial and political costs of a deployment of ground troops. In this chapter I argue that the reason that states do not do this more often is that by giving up the option of using ground troops, they are losing a lot of control over the outcome of the campaign. For example, in the case of the NATO

[33] Of course, it can be argued that beyond the air campaign, the Serbs were convinced to capitulate by the possibility of a NATO ground campaign (which NATO did appear to be preparing for) and warnings from Russia that they would not protect Serbia from an attack. Still, this does not take away from the dominance of air power in the Kosovo campaign.

bombing of Libya in 2011, NATO had to rely on rebel Libyan forces to be the ones to actually bring down Qaddafi's regime, regardless of the strategy they were using on the air. Thus, the ultimate outcome of the campaign came to depend not on the efforts of NATO itself, but on local rebel forces, many of them poorly trained and disorganized. Also, we should keep in mind that although the NATO campaign in Serbia was successful in destabilizing the Milosevic government, the human costs of the war was extremely high. It might be the case that a substantial NATO ground presence would have been able to prevent the Serbs' ethnic cleansing campaigns that UN peacekeeping troops were unable to stop[34].

When combined with air power, ground troops will play three very important roles in support of the air power. First, ground forces can help to identify targets on the ground. Whether an attacker is using a modern or a non-modern aerial strategy, the success (and also the duration) of the aerial campaign will depend in large part on having enough intelligence to correctly identify where its intended target is located. Gathering this intelligence from the air can be difficult, as targets can be camouflaged (for example, tanks in the desert are often covered with netting that allows them to blend in with the sand) or hidden (for example, a factory may be operating in what from the air appears to

[34] As the former Yugoslavia began to dissolve in the 1990's, Bosnia became a particularly difficult area to manage because of the large populations of Serbs, Croats and Bosnian Muslims. With the declaration of Bosnian independence in 1992, the conflict turned into an international one (with Serbia and Croatia supporting Serbs and Croats against Muslim Bosnians. The conflict was extremely violent, with violence from all sides, but particularly from the Serbs, who engage in ethnic cleansing campaigns against Bosnian Muslims. The United Nations Protection Force (UNPROFOR) was sent into Bosnia, with the aim of preventing this violence. The peacekeeping force, composed mostly of European troops was a traditional peacekeeping force, lightly armed, with orders to fire only in self-defense and to stay neutral. One of the ways the peacekeepers attempted to protect the Bosnian Muslim population was through the designation of certain Bosnian cities as "safe havens," where civilians could find safety from the war under the protection of the peacekeepers. The UN peacekeepers, though, were ill-equipped for carrying out their mission of protecting Bosnians civilians. This is perhaps most obviously illustrated by the massacre of 7,000 Muslim men and boys that occurred when Serb forces overran the safe haven of Srebrenica, with the 600 Dutch peacekeepers in charge of it being able to offer little resistance (Simons 2007).

be an abandoned building). Forces on the ground are better able to identify these targets, by getting close to them and observing past the camouflage. In fact, ground troops can even mark the target for the air power, reducing room for error.

With good intelligence on the location of a target, an aerial campaign will be expected to be shorter. Air power will waste less time trying to guess where the enemy targets are located and will be able to hit them more quickly, which, all else being equal, should end the conflict sooner than it would without this intelligence. In cases in which there are no ground troops present, or if the ground troops are independent from the state conducting the aerial attack (such as the rebel Libyan troops were from NATO in 2011), then the attacker has less reliable intelligence and has to rely on more trial-and-error attacks in order to achieve its aims. For example, when the United States began its bombing campaign in Iraq in 2003, it initially attempted to destabilize the regime by killing Saddam Hussein. This aim was not achieved, as Saddam turned out to not have been in the location where the Americans expected him to be at. We can imagine that if the Americans had had better intelligence on his location they might have been able to assassinate him and this could have significantly shortened the length of the bombing campaign in Iraq. Though it is the modern system that relies on the identification and destruction of key targets, intelligence is also important under the non-modern system. For example, even if the aim of an aerial bombardment is to bomb the opponent's fielded tanks, it is still important to know where the tanks are located. Otherwise, valuable air power time and resources will be spent on reconnaissance missions trying to locate the tanks before the bombardment begins.

The second role that ground forces will play in support of air power will be to provide post-bombing assessment. Whenever any sort of aerial bombing is carried out, it is important to know whether the intended target was actually destroyed by the attack. If it was not, the attacker will likely have to go through and bomb the target again (sometimes several times) in order to achieve its aims. If there is some uncertainty as to whether a target was destroyed, it may be in the interest of the attacking state to go through and bomb it again, to be sure that the target was destroyed. This bombing (potentially redundant) of the same target can increase the duration of the aerial campaigns. Also, if the attacking state believes that it destroyed a target but didn't actually do so, it may discover its error in the future (for example, it may discover that a factory it had bombed remains operational) and have to go back and bomb the same target.

Ground troops can serve the role of providing this post-bombing assessment for air power. As with the case of intelligence, post-bombing assessment is easier to do from the ground than it is from the air. Ground troops can provide more accurate information about whether a target was destroyed or needs to be hit again. As mentioned earlier, the use of combined arms can lead to swifter victories. This should, all else being equal, lead to shorter aerial campaigns.

Finally, ground forces should be able to combine with air power to increase the overall effectiveness of the aerial campaign. A combined arms approach seeks to conduct a military campaign using different forces that are able to complement each other. In this case, ground power may be a complement to air power, making up for its shortcomings and providing it with new advantages that will lead to increased

effectiveness. Combined arms attacks are expected to be more effective because they present more complicated threats to enemy units. In the case of an aerial campaign that is integrated with ground forces, opponents will have a more difficult time defending against the attack. For example, to defend against an aerial attack, it might make more sense to spread out the artillery units, so that they will not make an easy target to bomb. In contrast, if the attack is coming from the ground, forces should be kept together so that no one unit can be surprised and overwhelmed by the opponent. If a state is simultaneously facing attacks from both the ground and air, it will have to trade off between defending against one or the other (House 1984).

If a combined arms attack is more difficult to defend against, it should also contribute to the effectiveness of air power. Thus, we should also expect the use of combined arms (which implies the presence of ground troops in these cases) to lead to swifter victories. Again, all else being equal, this will lead to shorter aerial campaigns.

Hypotheses

Having explored the role that ground troops can play in affecting the outcome of aerial campaigns, I will now focus on deriving specific hypotheses that will allow us to evaluate some of these ideas.

Before taking ground power into account, I will begin by drawing up a general hypothesis on the effect that I expect modern aerial strategies to have on the duration of an aerial campaign. Modern aerial strategies rely on destroying key targets and expecting them to have a multiplicative effect on the rest of the system, such that the opponent can be defeated without necessarily destroying its capability to keep fighting. This means that we should expect these campaigns to conclude faster, because they rely on simply

destroying key points to destabilize the opponent and get them to capitulate, as opposed to destroying enough of the opponent's forces to prevent them from continuing to fight, which should take longer. Thus, the first hypothesis to be tested in this chapter will be the following:

Hypothesis 2.1: Aerial campaigns that use the modern system should have a shorter duration that those that use the non-modern system.

Of course, the aim of this chapter is not only to think about how aerial strategies affect campaign durations, but also about how they can interact with ground strategies to affect the characteristics of bombing campaigns. Thus, it is important to think of what role ground troops will play in determining the outcomes of bombing campaigns. As stated before, I will make the point that ground troops can also serve to shorten the length of bombing campaigns. Ground troops can serve three purposes, that of providing intelligence that helps to identify where targets are (which should reduce the number of tries it takes to destroy a desired target), that of providing post-bombing assessment (which means that states will know whether they have hit the targets they want and will not have to fly extra sorties to make sure that the targets are hit), and that of increasing the effectiveness of an aerial campaign through the principles of combined arms. All three of these mechanisms should lead to shorter air campaigns, even independently of the aerial strategy being used. Thus, we can derive the second hypothesis:

Hypothesis 2.2: Air campaigns involving the presence of ground troops should be shorter than those without ground troops.

These are the independent effects that we can expect aerial strategies and the presence of ground troops to have on the duration of bombing campaigns. It is also important to think about how ground troops can affect the outcome of bombing campaigns when particular aerial strategies are being used.

As stated previously in this dissertation, campaigns that use the modern system of air power rely strongly on good intelligence on the ground to mark what the key, decisive targets are. Thus, even though the presence of ground troops should decrease the duration of aerial campaign, it should make an even larger difference in the case of modern aerial campaigns. To consider this possibility, I will derive the third hypothesis:

Hypothesis 2.3: The interaction of modern air power and the presence of ground troops will lead to a shorter duration of aerial campaigns.

While air-only campaigns such as the ones in Kosovo and Libya can get a lot of press attention, most cases of uses of air power will involve some sort of a ground component. In other words, air-only wars are a rarity. While air power has gained importance in recent years, it still remains true that it is often used in support of ground troops. This means that when we evaluate the effectiveness of an air campaign, we have to consider the fact that the outcome of the conflict is also going to depend very heavily on what the ground troops are doing. In a joint campaign that involves ground and air elements, the different military forces will have to coordinate in order to achieve the best outcome. In fact one of the principles behind an effective combined arms approach is that forces should be operating under the same doctrine, and should ideally even have trained together (House 1984). This means that certain combinations of air and ground

strategies should be more effective than others at achieving the desired outcomes of the state at a lower cost.

. In the analysis to follow I will consider two possibilities. The first will be that the strategy of the ground troops does not really affect the characteristics of the aerial campaign (such as outcome or duration). Rather, it is simply the presence of the ground troops, and the informational role that they serve, that can affect how an aerial campaign plays out.

The other possibility is that the strategy of the ground troops will interact with the aerial strategy and affect the characteristics of the aerial campaign. Using the modern system in the air relies on hitting key targets that will have a disproportionate effect on the opponent's ability to function. This means that these sorts of attacks will often create a temporary window of opportunity that has to be exploited. In other words, the modern aerial attacks will not necessarily create an absolute victory for the state that is using them, but rather they will interrupt the functioning of the opponent enough to allow for more costs to be imposed on them. If this window of opportunity is not well taken advantage of, the opponent may recover from the aerial attack and continue to fight. This means that modern aerial attacks will likely not create military success on their own, but rather provide an opportunity for ground troops to more easily achieve this success. Because these windows of opportunity are often temporary, the ground troops must also be operating under the same mentality as the air power, focusing on momentum and amplifying the effect of attacks. This focus on momentum and attacking the opponent's weak points is what the modern system refers to on the ground. This means that we can

expect coordination between modern air and ground strategies to make campaigns go by faster. Thus, we can also derive the following hypothesis:

Hypothesis 2.4: Modern aerial attacks are more likely to lead to shorter campaigns in cases in which the modern system is also being employed on the ground.

To test these hypotheses I will be using the coding for aerial strategies and conflict outcomes that were previously mentioned, as well as a variety of control variables. When it comes to the strategy on the ground, I will use the new coding of ground strategy that I have collected for this dissertation. As stated before, it would be ideal to be able to use a previous dataset on ground strategy. The problem with doing this is that none of these datasets contain strategy variables that refer specifically to military strategy on the ground. Rather, they take into account both military strategy on the air and on the ground. Seeing as my aim in this chapter will be to understand the effect of ground strategies on the effectiveness of aerial strategies, I could not use these datasets in my analysis.

Testing the Theory

I will begin by testing the first three hypotheses of this chapter, hypotheses 2.1-2.3, which state that bombing campaigns should be shorter when the modern system is being used in the air, when there are ground troops present, and in particular when ground troops are being used along with modern aerial campaigns. One way to think about this will be to think of there being four potential types of campaigns, based on whether there are ground troops present or not and the sort of aerial strategy that is being

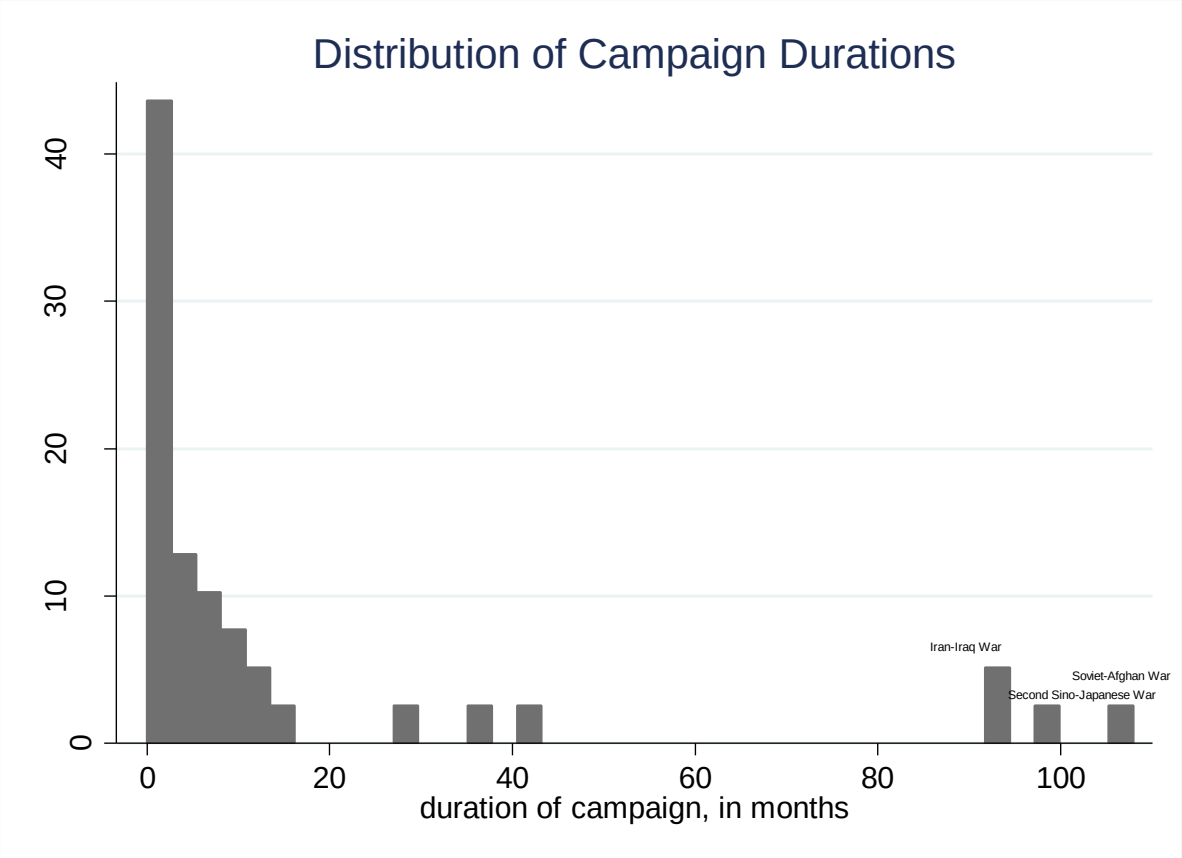
used by the attacker. As we can see from the table below, though there are significantly more cases in the category of ground troops coupled with non-modern air power, there are observed cases in each category, which should facilitate the evaluation of these hypotheses.

Table 6.2: Distribution of Cases

Ground Troops, Modern Air Power (GM) (20% of cases, n=8)	Ground Troops, Non-Modern Air Power (GN) (50% of cases, n=20)
No Ground Troops, Modern Air Power (NM) (12.5% of cases, n=5)	No Ground Troops, Non-Modern Air Power (NN) (17.5% of cases, n=7)

The dependent variable is drawn from Allen's (2007) piece on the duration of bombing campaigns. It is a continuous variable that measures the duration of a bombing campaign in months. The following graph shows the duration of the bombing campaigns. As we can see from the graph below, most campaigns will tend to be shorter, lasting less than 2 years. The longest observations refer to cases that can be considered outliers, such as the Soviet intervention in Afghanistan and the Iran-Iraq war. The mean duration of a campaign is only around 15 months (including the outlier cases).

Figure 6.1: Distribution of Campaign Durations



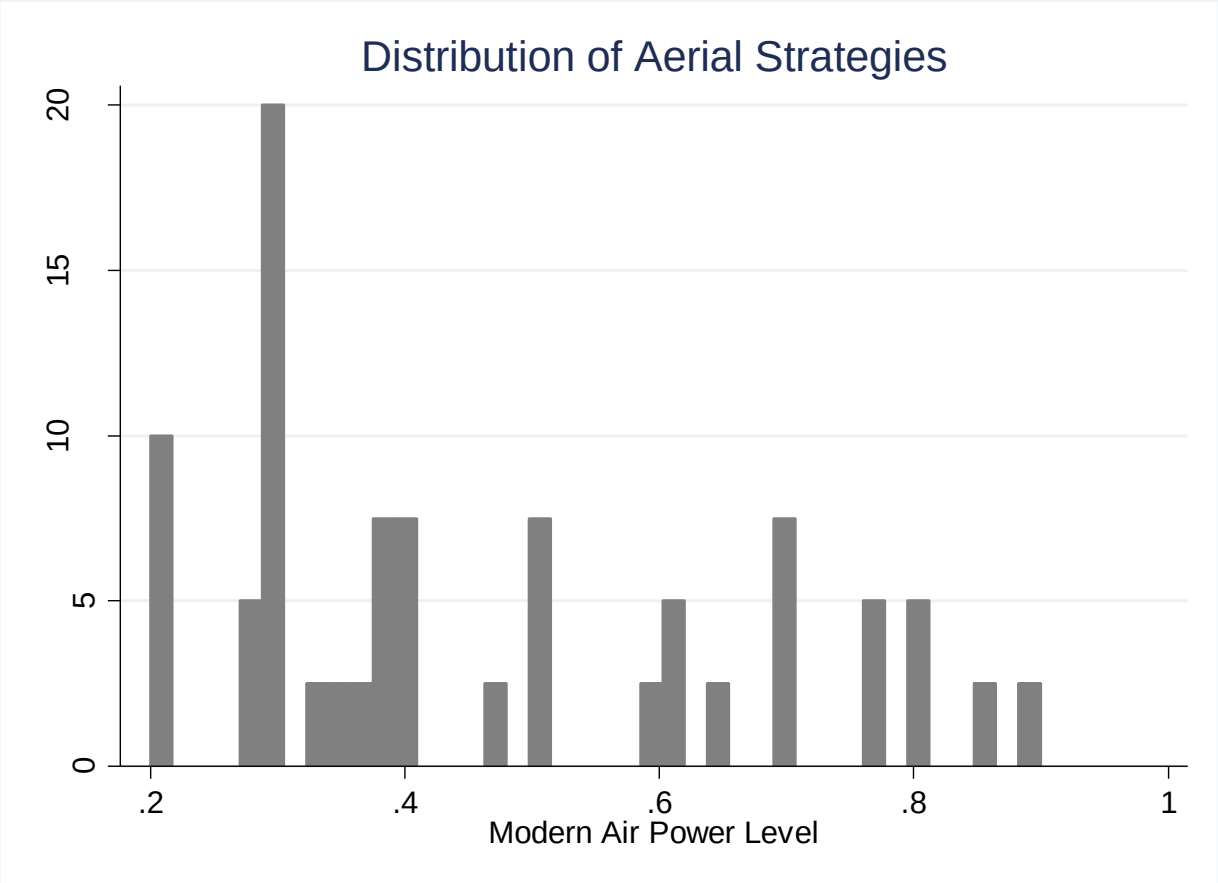
The independent variables will include a measure of how modern the use of air power was in that conflict (measured as a percentage, with higher values indicating more modern uses of air power)[35]. This is the same measure of aerial strategy that was used in

[35] As mentioned earlier in this dissertation, I have identified the characteristics of modern and non-modern air power under each one of the three forms of air power (CAS, interdiction, strategic attack). I then design questions that identify the key characteristics of modern and non-modern air power, with each one being answered in the affirmative or negative. To provide an example, one of the questions under the modern interdiction section asks, "Are lines of communication and transportation (bridges, highways) being targeted?" (as I discussed before, targeting the lines of communication and cutting off the enemy's troops from their command and control is one of the key elements of the modern system). Under the non-modern interdiction section, a sample question reads, "Are combat forces (ie the actual troops, tanks, etc) being targeted?" (under the traditional, non-modern form of fighting the aim of attack is to destroy the actual troops so that they will no longer be able to resist).

The answers to these individual questions are then aggregated to form an overall index of how "modern" a particular use of air power is. In each case, only the answers from the dominant use(s) of air power are considered for that case's classification. Affirmative answers to questions related to the use of modern air power are added to the score, as are negative answers to the questions referring to the use non-modern air power. As the number of questions varies between categories, the "modern score" is normalized to a score between 0 and 1, which essentially represents the percentage of questions that

the previous chapter, and that was derived using the data coded for this project. The histogram below shows the distribution of values for the uses of air power, showing how modern a state's strategy was.

Figure 6.2: Distribution of Aerial Strategies



As we can see from the figure above, there are relatively few cases at the higher end of the modern spectrum. The mean value for modern air power level is .47 and the modal category is .3. Cases on the higher end of the spectrum include campaigns such as

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indicate the use of the modern system. The higher that number is, the more modern that one particular case can be considered to be.

NATO's Deliberate Force Operation against the Serbs and the United States' attacks during Desert Storm.

I will also include a dichotomous variable that measures whether there were ground units present. Note that this variable measures whether the *attacker* had ground units present. In other words, if the bombing is in support of local forces (we can think of the NATO campaign in Libya in 2011 as an example), this would not count as a case in which ground units were used. This is because I am assuming that ground units that are not part of the attacker's forces cannot be relied upon to execute strategy and coordinate like the ground units of the attacker could.

To understand the effect that ground troops have on the effectiveness of the aerial strategies I will also include an interaction between the use of ground power and the use of the modern system.

As a control variable, to represent the advantage that stronger attackers have in conflict, I will include a variable for the military power ratio between the attacker and the target. It may be the case that campaigns being fought by more powerful attackers will end sooner as the attacker is able to more easily overwhelm its opponent. Conversely, it may also be the case that stronger attackers are able to keep a bombing campaign going for a longer period of time because of their greater resources. To measure the power ratio between the two states I will use the ratio of their CINC (Composite Index of National Capability) score (Singer, Bremer and Stuckey 1972, Singer 1987). This of course is a surrogate measure, which measures the industrial capabilities, population and military personnel/expenditures of states. Still, the CINC score is a widely used measure that is generally accepted as a measure of military power.

I will also include a post-1950 control variable, to represent the possibility that as weapons systems became more sophisticated they allowed for shorter campaigns. I will also include a post-1970 control variable to represent the first uses of smart bombs, allowing for the possibility that this new technology may have affected the duration of aerial campaigns[36]. Finally, I will include (from Allen (2007)) a variable that controls for whether the attacker was making a demand of the target that was large and salient (such as regime change (Allen 2007, Horowitz and Reiter 2001)). The idea behind this control variable is that we should expect targets to be less likely to capitulate in cases in which there is a large demand being made of them. This variable is coded dichotomously, with a one representing a large demand.

Because I am working with duration data, in my analysis I will use a Weibull duration analysis. The Weibull duration model is restricted by the fact that it has a monotonic baseline hazard. In this case I find it appropriate for this set of data because I can make the assumption that the baseline hazard will be increasing. In other words, the probability of a campaign ending in a given period will increase as time goes by (Box-Steffensmeier and Jones 2004). As we can see in Table 2.1 below, the shape parameter in this regression is greater than one, showing a hazard rate that is monotonically increasing with time. In this case I will use the accelerated failure-time form of the Weibull model, which means that positive coefficients will indicate a longer duration and negative coefficients will indicate a shorter duration(because in the AFT form the effect of a covariate is to multiply the predicted event time by a constant)[37].

[36] As mentioned in the research design chapter, I tried using a few different dates (such as 1945 or 1973) to define this variable and obtained similar results.

[37] The accelerated failure-time form of the model will also be robust to the possibility of omitted variables (Box-Steffensmeier and Jones 2004)

Below, in table 6.3, I present the results of the Weibull regression analysis, in which the coefficients (as well as the standard errors) are presented:

Table 6.3: Weibull Duration Analysis: Duration of Aerial Campaigns
(Accelerated failure-time form)

	Coefficient (standard errors)
Modern Air Power	-8.38*** (2.60)
Ground Forces Present	-2.42* (1.40)
Interaction of Modern Air Power and Ground Forces Present	7.65*** (2.71)
Post-1950	1.32 (1.14)
Post-1970	0.16 (0.93)
Demand	1.02 (0.67)
Power ratio	-0.003 (0.009)
n	40
Log likelihood	-77.71
Shape parameter	1.48 (0.19)
(Wald) Chi2 (p-value)	22.05 (0.003)

***significant at .01 level, **significant at .05 level, *significant at .10 level

To assess the fit of the model we can run a likelihood ratio test, comparing a null model that includes only the control variables to one in which we add the variables for the aerial strategy, the presence of ground troops, and the interaction between the two. In this case the LR chi-squared is equal to 9.82 and the probability of obtaining the chi-squared statistic if there were no effect of the variables is equal to 0.0201. We can also perform a Wald test of the whole model. In this case the chi-square is equal to 22.05 and

the probability of obtaining the chi-squared statistic if there were no effect of the variables is equal to 0.0025.

As we can see from Table 2.1, both the presence of ground troops and the use of the modern system contribute to campaigns ending more quickly. This finding supports hypothesis 2.1, which argues that modern campaigns do not rely on completely destroying the enemy (which we can consider to be a more time-consuming endeavor), but rather on maintaining momentum and creating windows of opportunity that can be exploited by the attacker. Thus, modern aerial campaigns can be expected to have a shorter duration than non-modern ones. This also supports hypothesis 2.2, which argues that the presence of ground troops will allow for the identification of key targets and the faster assessment of attacks on the ground, which should lead to a faster conclusion of the bombing campaign.

As can be expected, bombing campaigns by stronger attackers are more likely to end sooner (though the coefficient on the power ratio is not actually significant), and campaigns that involved large demands will drag on for longer. We should also note that while the coefficients for the power ratio and the post-1950 variable are both positive, they are not significant.

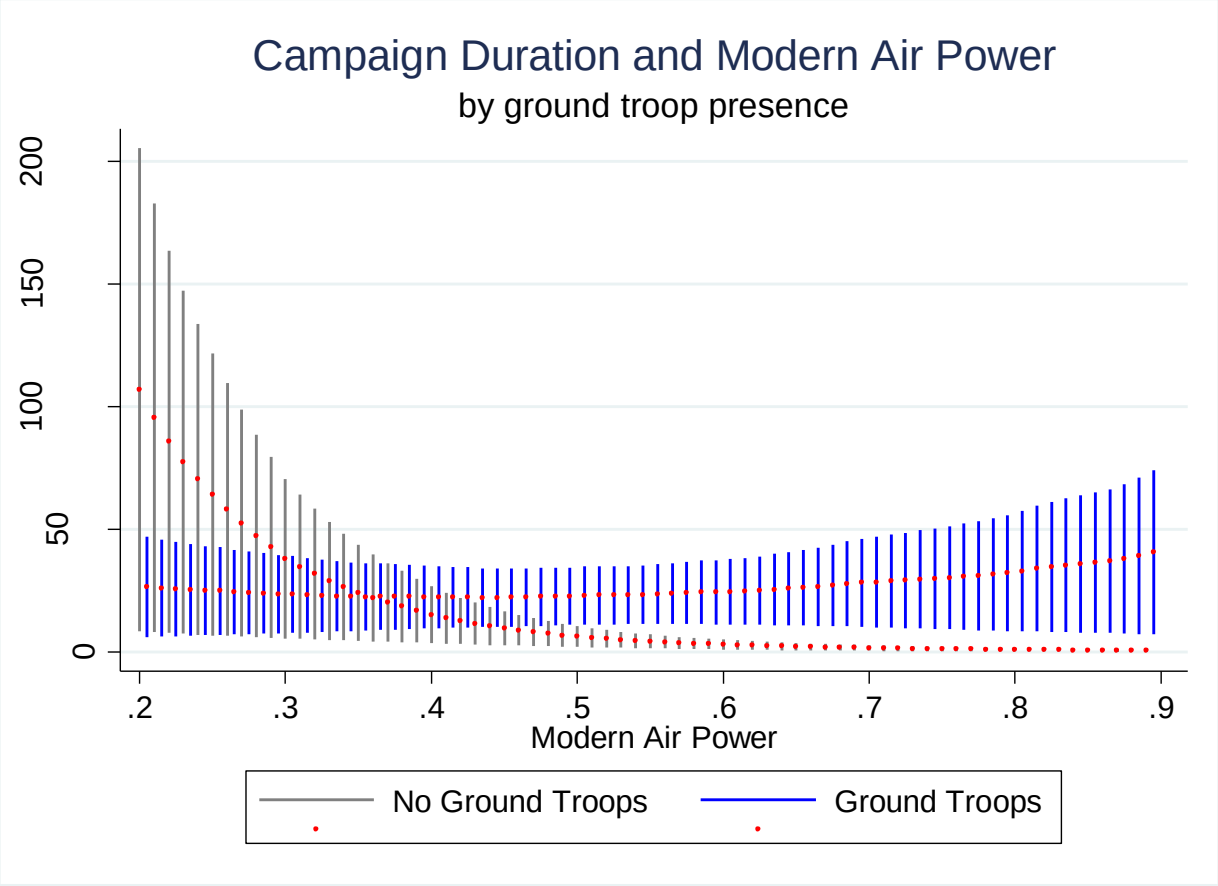
A somewhat odd finding is that the interaction term between the presence of ground troops and the modern system has a significant coefficient, but it is in the opposite direction than would be predicted by the theory (and by hypothesis 2.3). The theory would predict that the presence of ground troops should decrease the duration of the bombing campaign, particularly when the modern system is being used. Instead, the results show campaigns lasting longer in cases in which the modern system is being used

along with the ground troops. Thus, it is important to further analyze the interaction between modern air power and the presence of ground forces.

Using Clarify (King, Tomz and Wittenberg 2000), I conduct Monte Carlo simulations to illustrate how both aerial strategies and the presence of ground troops will affect the duration of bombing campaigns. In these simulations the values of all control variables were set at either the mean (for continuous variables) or median (for dichotomous variables).

In the graph below I present the expected duration of aerial campaigns as the level of the use of modern air power increases, for cases in which ground troops are used as well as for cases in which there are no ground troops. In the graph the dots represent mean expected durations, with the lines representing the 90% confidence interval around that mean value. The light grey lines represent the cases in which there are no ground troops and the dark grey lines represent the cases in which there are ground troops present. The aerial strategy of the state is represented on the x axis, going from the least to the most modern strategy. Campaign duration is on the y-axis.

Figure 6.3: Campaign Duration and Modern Air Power



The graph above is particularly interesting in that in the case in which there are no ground troops present, we see expected duration behaving as we would have expected it to under our hypotheses. As the proportion of modern air power being used increases, the expected duration of the bombing campaign decreases. Also, as the proportion of modern air power being used increases, the variance around expected duration also decreases. What is interesting to note is what happens in the cases in which we introduce the presence of ground troops.

When the level of modern air power being used is low, we can see that adding ground troops decreases the duration of aerial campaigns, as is predicted by hypothesis 2.2. This is in accordance with the explanation that suggests that ground troops are able to serve an informational role that allow air power to identify its targets more easily and effectively and conclude the bombing campaign in a shorter period of time.

What is interesting is that when more modern air power is being used, the addition of ground troops leads to longer expected duration of conflicts, as well as greater variances around this estimate. This appears to explain the unexpected negative coefficient on the interaction term in the analysis. It seems to be the case that what ground troops are really doing is moderating the duration of the aerial campaigns. As we can see from the graph, the mean duration of conflict tends to remain somewhat stable when ground troops are used in conjunction with the air power. Thus, in cases in which the less modern air power is being used, the addition of ground forces allows for shorter campaigns. This may be because the ground troops are serving the role of providing information that can be utilized by air power, and allow it to overcome some of its shortcomings. In the case of the most modern cases of air power, though, it seems that the presence of ground troops removes the option of the quickest sorts of campaigns, in which the air power can just come in, bomb, and leave. Once ground troops are involved, ending the campaign becomes a more complicated and time-consuming process.

While in order to truly assess whether this was the effect of adding ground troops under different circumstances we would have to replicate the different campaigns while modifying only the presence of ground troops, we can still look to the data and see if it seems to support these conclusions. Out of the cases in which there were no ground

troops present, the case with the highest score for modern uses of air power is that of Operation Deliberate Force, conducted by NATO against Serbia in 1995. This was a case in which targeted attacks were carried out in order to reduce the Serbs' military capability to attack "safe areas" in Bosnia. The attacks were meant to isolate both the leadership as well as Serbian fielded forces, as well as to destroy selected infrastructure. Though there were UN Rapid Reaction Forces present in Bosnia, NATO itself never committed any ground troops. The duration of this aerial campaign was only two weeks, which is significantly shorter than the mean duration of 15 months.

In contrast, the least modern (as far as air power goes) of the air-only campaigns is that of the 1940-1942 British bombing campaign against Germany. This campaign was happening at a time in the war when Britain had adopted a policy of attacking large towns through area bombing (much of this following the ideas of Sir Arthur "Bomber" Harris of the Royal Air Force). The aim of these attacks was not only destruction but the shattering of civilian morale through the use of incendiary and high-explosive bombs. This campaign lasted for 14.5 months, less than the mean (which is of course driven up by a few outlier cases), but much longer than the two-week duration of Operation Deliberate Force. Our first reaction might be to attribute this to the time period in which these campaigns were being carried out, and to argue that the British bombing of Germany had a larger duration because it happened over fifty years before Operation Deliberate Force. This may be a possibility, but we can also point to the case of the least-modern air campaign that did include ground troops. This is the case of the Italian bombing of Ethiopia during the Second Italo-Ethiopian War of 1936. This was obviously a case closer in time period to the British bombing of Germany, and was also very non-

modern (for example, many of the bombing sorties focused on the actual masses of Ethiopian soldiers). This case, though, which included a large presence of Italian soldiers, lasted for only 7 months.

Of course, this analysis only speaks to the duration of bombing campaigns, while what we really are interested in is whether campaigns are short *and* successful. In order to understand the effect of the aerial strategies on the duration as well as outcomes of campaigns, I will use a competing risks model. The competing risks model takes into account the difference between cases in which the campaign ended because the outcome of it was successful and cases in which the campaign ended because the outcome was unsuccessful. In the first model, the success model, cases that don't end in a success will be treated as right-censored (as explained by Allen (2007), this is because these cases never end in a successful outcome). In the second model, the failure model, cases that don't end in a failure are treated as right-censored (because these cases, the successes, will never end in a failed outcome).

Below are the results for both the success and failure models:

Table 6.4: Competing Risks Model

Competing Risks Model

	Success Model Coefficient, (Standard Errors)	Failure Model Coefficient, (Standard Errors)
Modern Air Power	-14.44*** (5.10)	-5.41* (3.25)
Ground Forces Present	-3.57 (2.87)	-1.67 (1.60)
Interaction of Modern Air Power and Ground Forces Present	10.58** (5.13)	5.82* (3.39)
Post 1950	3.49 (2.45)	0.47 (1.28)
Post 1970	0.20 (2.21)	0.26 (0.97)
Demand	1.12 (1.32)	0.88 (0.77)
Power Ratio	-0.02 (0.02)	0.003 (0.010)
n	40	40
Log likelihood	-45.44	-54.66
Shape parameter	1.80 (.41)	1.32 (0.21)
(Wald) chi2 (p-value)	15.96 (0.03)	7.21 (0.40)

In the success model, the variable that measures the use of the modern system remains significant and has a negative coefficient, which means that it contributes to campaigns ending in success sooner. What is interesting is that the ground variable loses it significance in this model. The interaction between ground troops and the use of the modern system remains significant but (again) in the opposite direction that the theory

would predict. In the case of the failure model the modern ground power variable again remains significant (and in the expected direction). The interaction term between modern air power and the presence of ground troops also remains significant but positive, as it did in the success model.

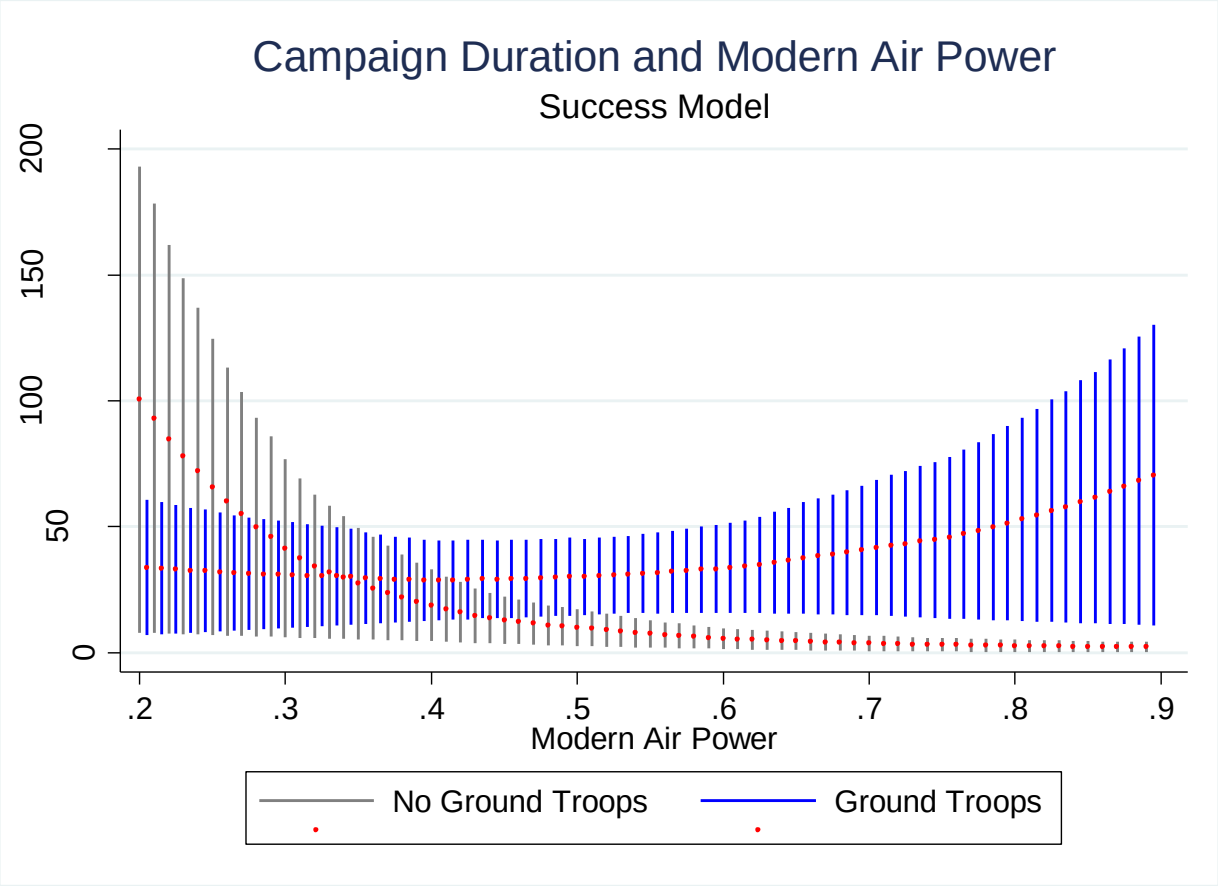
A somewhat odd finding from this analysis is that once we take the outcome of the campaign into account, the coefficient on the "presence of ground troops" variable becomes insignificant. This may be because ground troops themselves may not actually have that strong of an effect on the outcome of a bombing campaign. What they might do is identify targets and help the campaign reach success sooner, or do bombing assessment that tells a state when to give up on the campaign (and cut its losses), but not actually affect the outcome of the campaign.

One example of this form of interaction between air and ground forces is that of the Algerian War. During the French air campaign against Algeria in 1962 (which is coded as a non-modern use of air power) the French adopted a policy of collective punishment in which villages that harbored rebel forces would be destroyed. This was generally done by ground forces, but villages that could not be reached by ground forces were bombarded by the French Air Force. This was a case in which the interaction of the air and ground forces was limited to the ground forces identifying the villages that harbored rebels and the air forces would then destroy these villages without the ground troops having to fight in them. While both air and ground forces were contributing to the aim of destroying villages that harbored rebels and decreasing Algerian support for the rebels, the aircraft involved depended on the ground forces only for information.

Another example of this type of interaction can be observed during the Russian-Chechen War of 1999 (also coded as a non-modern use of air power). In this case, the Russian troops originally expected artillery and air strikes on Chechen cities to lead to a decisive victory, which meant that they really had no contingency plans involving the interaction of the ground and air forces. Once it became obvious that Chechen resistance was stronger than had been expected, Russian ground troops that moved into Chechnya would keep mobbing if they found no resistance. If resistance was encountered, the town would be sealed off and bombarded with either artillery or air power. Again, in this case we can see how the ground forces played a large role in identifying targets, but the interaction between air and ground strategies was somewhat limited.

As for the positive coefficient on the interaction term, we can use the same method as we did in the previous model to show what the actual effect looks like (King, Tomz and Wittenberg 2000). Below I present substantive effects for both the cases of the success and the failure model:

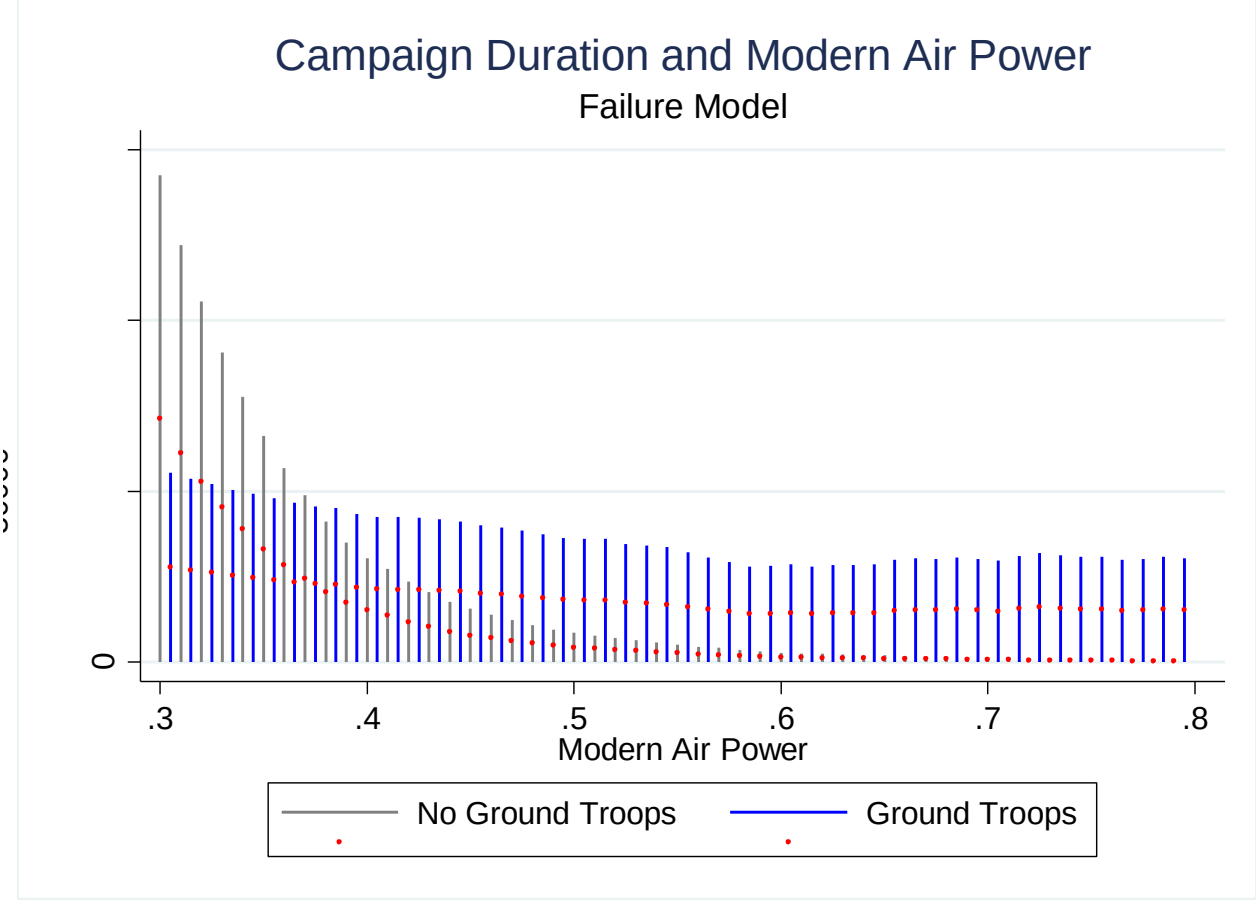
Figure 6.4: Campaign Duration and Modern Air Power, Success Model



In the case of the success model we can see that the general pattern of the substantive effects resembles that of the joint model. In the case in which there is no ground troop presence there is a clear decline in the duration of conflict as there is an increase in the use of the modern system of air power. When adding in ground troops (again, the dark lines in this case), expected duration is lower than it would be in the cases of no ground troops when the aerial strategy is less modern. Similarly to the first model, at high levels of modern air power, ground troops lead to longer expected durations.

The same is true in the case of the failure model:

Figure 6.5: Campaign Duration and Modern Air Power, Failure Model



These two graphs illustrate how the presence of ground troops can help to moderate the duration of aerial bombing campaigns, whether these are campaigns that end in success or in defeat. Thus, it appears to be the case that more modern aerial campaigns, while they will not always lead to victory, will lead to faster victories. Of course, they will also lead to faster defeats. In both cases, the presence of ground troops moderates this expected duration, taking away the option of very quick defeats or victories in the case of the most modern campaigns, but also shortening the less modern campaigns.

The next step will be to test hypothesis 2.4, which states that modern uses of air power will be more useful when combined with modern uses of ground power. To measure ground power I will be using the newly-coded ground strategy variable that measures how modern the uses of ground forces are (see Chapter 4 for a more extensive description). This measure is analogous to the air power variable, meaning that it can be measured both as a percentage or dichotomously.

The dependent variable in this analysis will again be the duration of the aerial campaign, measured in months. While the ultimate aim of a project of this sort is to understand the effect of air power on conflict outcomes, while taking into account factors such as the actions of troops on the ground, at this point I will use duration as a dependent variable[38]. Besides duration itself being of interest as an independent variable (after all, it makes sense that states would want to know the expected duration of an aerial campaign they are about to engage in), I have argued before that campaign duration can be an indicator of the type of outcome of a campaign.

The dependent variable is drawn from Allen's (2007)piece on the duration of bombing campaigns, which is in turn drawn from work by Pape (1996) and Horowitz and Reiter (2001). It is a continuous variable that measures the duration of a bombing campaign in months.

Below I present the results of a Weibull duration analysis in which I include a variable for the type of ground power that is being used, as well as an interaction between the air and ground strategies of the attacker.

[38] Current data on bombing campaign durations measures outcomes dichotomously. Because several of the hypotheses in this work refer to the variation in outcomes, this data is problematic. One possibility would be to use a heteroskedastic probit analysis, but the small size of the sample makes it difficult to apply this model with confidence.

Table 6.5 Weibull Duration Analysis: Duration of Aerial Campaigns
(Accelerated failure-time form)

	Coefficient (standard errors)
Modern Air Power	0.05 (3.08)
Modern Ground Power	0.76 (2.04)
Interaction of Modern Air Power and Modern Ground Forces	-1.88 (3.64)
Post 1950	1.72 (0.89)
Post 1970	-0.45 (0.86)
Demand	0.76 (0.60)
Power ratio	-4.46 (2.86)
n	33
Log likelihood	-64.66
Shape parameter	1.55 (0.22)
(Wald) Chi2 (p-value)	9.21 (0.24)

***significant at .01 level, **significant at .05 level, *significant at .10 level

As we can see from the table above, none of the major variables in this analysis have significant coefficients. Thus, it appears to be the case that the strategy of ground troops does not affect the characteristics (in this case, duration) of bombing campaigns. Of course, part of the reason for the lack of significance in these results may be the fact that I am working with a very small sample size that makes it difficult to draw conclusions on this question. Still, these results seem to show that it is really the modern

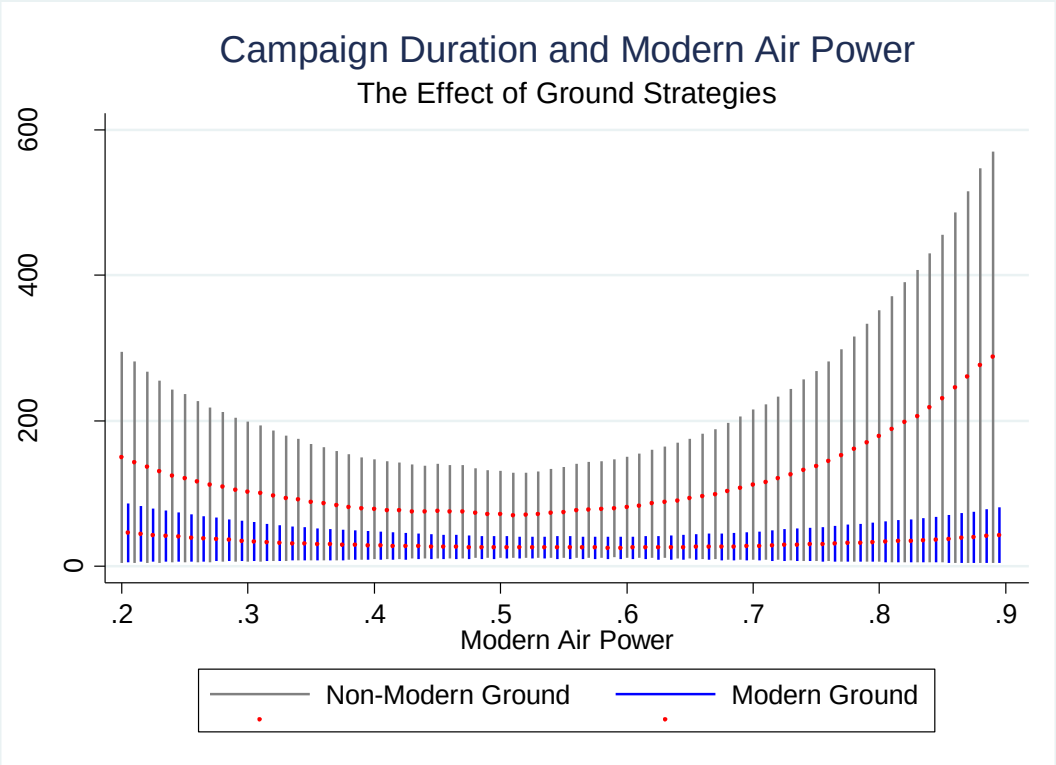
system of air power that determines the duration of a bombing campaign, and that it does not really matter what the ground troops are doing. This may seem like a counterintuitive conclusion to reach, particularly because it is the case that air power is often deployed in support of ground troops. Still, note that this analysis is referring to the duration of only bombing campaigns. Thus, it may be the case that when it comes to the duration of aerial campaigns, the ground troops really do just play more of an informational role, supplying intelligence and bombing assessment to the air power. What the strategy of the ground troops may have a real effect on will be the characteristics of the conflict as a whole. So, in this case, it is likely that the strategy of the ground troops would affect the duration of the conflict as a whole, but not of the bombing campaign.

In the case of this analysis we can also look at what the substantive effects would look like. I again use Clarify (King, Tomz and Wittenberg 2000) to create Monte Carlo simulations that will show what the effect on duration is of using the modern system on the ground, for various levels of modern air power. In the graph below, the grey lines represent the 90% confidence intervals around the estimated mean duration of an aerial campaign that is being carried out in conjunction with a non-modern ground strategy, for several different levels of modern strategies. The blue lines represent the 90% confidence intervals around the estimated mean duration of aerial campaigns carried out alongside modern ground strategies[39].

[39] Note that to create this graph I used a dichotomous measure of modern ground power. This was done in order to more clearly illustrate the substantive effects of changing over from modern to non-modern ground power. The variable is coded as 1 if the value for the ground strategy is greater than the mean and 0 otherwise.

We can see from the graph that the duration of the campaign seems to be shorter in cases in which the air power is being used in conjunction with modern ground power. Still, this does not really support hypothesis 2.4 because the hypothesis predicts that campaigns will be shorter when modern ground power is combined with modern air power. The graph shows that modern ground power leads to shorter campaigns at all levels of modern air power. The only potential support for the hypothesis could come from the fact that the decrease in mean duration (from switching from non-modern to modern ground power) is larger in the most modern uses of air power. Still the lack of significance of all of the coefficients in the analysis makes it risky to draw conclusions from the substantive effects[40].

Figure 6.6: Campaign Duration and Modern Air Power, the Effect of Ground Strategies



[40] Running a Wald test on the original Weibull analysis gives us a chi-squared value of 9.21, with Prob > chi2 being 0.2377

Note that this is because we are referring solely to cases of the duration of bombing campaigns, not the outcome of the war as a whole. In order to really be able to understand the interaction of ground troops and air power it might make more sense to look at the duration of the conflict as a whole.

Other Possibilities

One more possibility that I would like to consider is whether the effect of using the modern system in the air on the duration of the aerial campaign is affected by the power ratio between the attacker and its target. It is possible that when an attacker that is much stronger than its target is using the modern system, it may be able to end the campaign sooner by taking advantage of the modern system's propensity to destabilize the opponent without necessarily having to destroy its ability to fight. Some might argue, though, that less powerful states are not able to fully take advantage of the benefits of the modern system, as they are not able to implement it correctly. In other words, it might be the case that if a state is heavily outnumbered when carrying out an aerial bombing campaign, it may be harder for air power to have the same effect that it otherwise would, regardless of the strategy being employed. To consider this possibility, I re-do the analysis from the first Weibull model and add an interaction variable between modern air power and the power ratio between the attacker and target.

As it is shown in the table below, adding this new variable does not dramatically alter the results of the analysis. The ground forces variable loses some of its significance, but this may be caused by the fact that we are adding yet another variable to an analysis that relies on a small dataset. Even so, the coefficient on all key variables remain in the

expected direction, and the modern air power variable, along with the interaction between modern air power and the presence of ground troops, remains significant. The coefficient on the modern air power-power ratio variable is negative (meaning that the combination of attackers that are more powerful than their targets and modern air power usage leads to shorter aerial campaigns) but not significant.

Table 6.6: Weibull Duration Analysis: Duration of Aerial Campaigns
(Accelerated failure-time form)

	Coefficient (standard errors)
Modern Air Power	-5.37* (3.22)
Ground Forces Present	-1.86 (1.37)
Interaction of Modern Air Power and Ground Forces Present	5.79** (2.82)
Post-1950	0.33 (1.30)
Post-1970	0.99 (1.03)
Demand	0.91 (0.66)
Power ratio	-0.06 (0.04)
Interaction of Power Ratio and Modern Air Power	-0.11 (0.08)
n	40
Log likelihood	-76.75
Shape parameter	1.45 (0.19)
(Wald) Chi2 (p-value)	27.08 (0.0007)

***significant at .01 level, **significant at .05 level, *significant at .10 level

Another possibility to consider is the role that ground troops that were not under the control or coordination of the air forces of the state carrying out the aerial attack played. I mentioned earlier in this chapter that the variable that measures whether ground

forces were present includes only cases in which the state carrying out the attack had its own ground forces present. Thus, cases of bombing that was done in support of local forces were coded as zeroes. This was because I assumed that ground forces that were not part of the attacker's forces could not be relied on to execute strategy and coordinate like the ground troops of the attacker could. Still, it could always be a possibility that some of these foreign ground forces do provide some support for aerial attacks.

In order to consider this possibility, I included a variable that measures the presence of ground forces. This is a dichotomous variable that was coded as "1" if there were ground troops present that had the following characteristics:

1) They were present in the target state's territory at the time of the aerial campaign.
2) They were troops not under the direct control of the attacker state
3) The troops were fighting on the same side as the attacker state.

To consider the possibility of these troops' influence, I re-do the analysis from the first Weibull model and add the "Other ground troops" variable.

Table 6.7: Weibull Duration Analysis: Duration of Aerial Campaigns (Accelerated failure-time form)

	Coefficient (standard errors)
Modern Air Power	-10.45** * (2.56)
Ground Forces Present	-3.10** (1.30)
Interaction of Modern Air Power and Ground Forces Present	8.84*** (2.52)
Post-1950	1.38 (1.02)
Post-1970	0.53 (0.85)
Demand	0.38 (0.64)
Power ratio	-0.003 (0.01)
Other ground troops present	0.39 (0.70)
n	40
Log likelihood	-73.34
Shape parameter	1.38 (0.19)
(Wald) Chi2 (p-value)	26.98 (0.0007)

***significant at .01 level, **significant at .05 level, *significant at .10 level

As it is shown in the table above, adding this new variable does not dramatically alter the results of the analysis. The coefficient on the ground forces variable remains significant and in the expected direction, as does the one on the modern air power variable. The interaction term between ground forces and the modern air system also remains significant and positive, as in the original analysis. The coefficient on the "other ground troops" variable is positive (meaning that the presence of ground troops not under the control of the state carrying out the aerial attack leads to slightly longer aerial campaigns) but is not significant, which means that we should be wary of generalizing too much from this result.

CHAPTER 7: THE STRATEGY OF THE OPPONENT

Up until this point I have discussed the choice of aerial strategy solely as part of one individual state's cost-benefit analysis, independently of its opponent's strategy. As stated before, though, the effectiveness of a state's air campaigns will depend strongly on the strategy that is being used by the other side. While in the first analytical chapter of this dissertation I argued that many of the decisions on military strategy and doctrine are made generally, not with a particular adversary in mind (or at least not with a particular war in mind), it is also the case that whether a strategy is successful or not depends strongly on the actions of the adversary that the strategy is being used on.

As Stam (1996) has suggested, there is often no "optimal" military strategy, but rather a best response to what the opponent is doing. Modern-system attacks often come with the possibility of large gains at low costs, yet they may not always be the optimal strategy to use. For example, the main characteristic of modern defense operations is that they are deep[41], meaning that they have to be less dense, as there is always a trade-off between depth and strength (if there is a fixed number of troops, and they are spread through a larger area, the density of troops per area will be lower). For attackers, deeper defenses thus mean that they have to travel longer distances under counterattack, but that this counterattack will be less dense. If the attackers are able to accelerate, then they can travel faster, which means that the defenders' deeper defenses will not actually allow them extra time to react (S. Biddle 2004). Biddle (2004) states that the modern system defenses are still effective against modern attackers because they are not able to

[41] In this case, a deep defense is one in which defensive troops are not placed only at the furthest edge of the territory they are defending, but also further into the territory.

accelerate enough without harming the modern methods. This implies, though, that the deeper defenses would not be as effective against a non-modern attack that was able to accelerate dramatically.

Thus, the effectiveness of a military strategy has to be evaluated in the context of the opponent's strategy. In this chapter I will go beyond the isolated decision of which form of air power to use and incorporate a decision that depends on the military strategy of the other side. This third analytical chapter will take into account the strategy of the opponent, and what effect it can have on the effectiveness of the aerial strategy chosen.

Besides the strategy being used by the opponent, this chapter will also take into account the opponent's characteristics. As Byman, Waxman and Larson (1999) state, it can be difficult to understand the relationship between a particular target and a desired outcome. Hitting a type of target can have a large effect on one adversary, leading it to capitulate, while that very same sort of target may hardly affect a different adversary.

The Strategy of the Opponent

Note that I have referred to the military strategy of the opponent, not necessarily to their aerial strategy. While this dissertation focuses on strategies of air power, I will be taking into account the general military strategy of the opponent, rather than their air strategy alone. The aim of aerial attacks is often to hit some target on the ground or to provide support for ground troops fighting an opponent on the ground. In fact, one of the ways in which states often attack the opponent's air force is by bombing aircraft on the ground (this is considered one more way in which aerial bombing can target the military capabilities of the opponent). Because of this, I will be considering how the opponent's

strategy on the ground can affect the probability of victory when using a particular strategy in the air[42].

We can begin to think of this third set-up as having a given state, State A, that is choosing whether to use a modern or a non-modern air strategy[43]. There is also another state, State B, which is the opponent, and it has chosen its strategy on the ground (it also has a choice between a modern and a non-modern strategy). The opposing state, State B, has also made a choice whether to use air power or not. Thus, basing ourselves on the theoretical model, we will determine in which cases the targeted system of air power will be most effective.

Hypothesis D from the theory chapter implied that as the mean value of using the targeted system increases, states should be more likely use the targeted system. Biddle (2004) makes the point that the best defense against a modern-system attack is a modern defense. Biddle makes this point when discussing two armies facing each other on the ground, but we can extend it to study what the best aerial strategy is against different strategies on the ground.

Modern ground strategies rely on deep, less dense defenses. Modern ground attacks will avoid defenses and aim to exploit temporary windows of opportunity. They use cover and concealment, as well as small subunits that operate independently to induce the collapse of the opponent's defense. Also importantly, modern ground attacks do not attempt to overwhelm all of the opponent's defenses, but rather they concentrate their

[42] I also have a variable for whether the opponent is using air power or not, which I include as a control variable in the analysis, because having to protect one's forces against aerial attacks may alter the effectiveness of an aerial strategy.

[43] I have stated before that an aerial strategy does not necessarily have to be purely modern or non-modern, but that it can be somewhere in between. At this point we can illustrate this as a choice between targeted and mom-targeted if we think of the state choosing what to do for an individual sortie. Thus, in the aggregate the state could end up with a mix of targeted and non-targeted strategy.

forces disproportionately at a given weak point, again to be able to break through and disrupt the operation of the opponent, with the expectation that this will lead to a systemic collapse (S. Biddle 2004). An effective aerial attack should therefore be able to stop the progress of these ground forces.

The more general, non-modern attacks, which aim to destroy the opponent and keep them from continuing to fight, should be able to halt any sort of ground force, if it is a large enough attack. In other words, a large enough aerial attacks that simply bombs everything and anything on the ground will of course mean that the opponent will not be able to continue to fight, as it has been completely annihilated. An attack of this sort may be unrealistic, both because most states do not have the capability to actually completely annihilate the enemy and because most will not be willing to be completely indiscriminate in their bombing of the opponent. Thus, we need to think about what sort of actual aerial attack will be more effective against a modern strategy on the ground.

In the realm of real, limited war, I will make the argument that the best way to counter modern ground strategies from the air is to also use modern aerial strategies. A modern ground strategy focuses on concentrating troops on particular weak points in the opponent's defenses, quickly overwhelming them, and destabilizing the opponent's forces by cutting them off from each other (S. Biddle 2004). Imagine that a non-modern aerial campaign is being used against this sort of attack. Biddle (2004) makes the point that traditional aerial surveillance (and attacks) tend to be, because of the nature of aircraft, intermittent. This means that ground forces will be able to enjoy extended periods when the air is clear of enemy aircraft. If the ground forces are implementing the modern system, they will take advantage of these breaks in air surveillance or bombing to

move from cover to cover. If they are able to move quickly enough (which is emphasized in the modern system), they may be able to complete the attack before the area is bombed. This means that traditional, non-modern air campaigns will be less effective against modern ground strategies. Also, indiscriminate, non-modern campaigns that targeted other elements that were not part of the modern system's concentrated force would be an inefficient use of resources, as the attack could have been stopped simply by bombing that stopped the progress of this one key attack.

In contrast, a modern strategy would identify the key points that, if destroyed, could stop the progression of this modern ground attack. In fact, a modern aerial strategy would not even have to destroy the forces carrying out the attack on the ground. Because the attack relies on momentum and surprise rather than on overwhelming forces, all that the air power might have to do is to slow it down. This could be achieved by a modern attack on the communications or supply line of the ground forces.

Thus, we can imagine that when the opponent is using a modern system on the ground, states will derive more value from using a modern system. We can then derive the following hypothesis:

Hypothesis 3.1: When the adversary is using a modern strategy, the effectiveness of a modern strategy of air power by the attacker will increase, relative to the non-modern system.

The Characteristics of the Opponent

Clearly the military strategy that the opponent is using will have an influence on how effective a given aerial strategy will be in conflict. That being said, it may be the

case that characteristics of the conflict that are beyond the control of either the state carrying out the aerial campaign or its opponent can also matter. Independently of what the opponent may be choosing to do on the ground, both its characteristics and the characteristics of the conflict may affect the effectiveness of different aerial strategies.

First of all, the environment in which the conflict is being fought, and in which the aerial campaign is being carried out, may determine how effective certain aerial strategies will be. In particular, we can think of the terrain in which the conflict is being fought. Byman, Waxman and Larson (1999) argue that in general, the use of air power will be less effective in mountainous, jungle or urban terrains. This will be the case because these types of terrain will make the identification of targets from the air more difficult than if the conflict were being fought in an open terrain. While the adversary cannot alter the terrain of the area in which the war is being fought, it can move to such areas that would make the use of air power more difficult and remove some of the coercer's advantages. For example, armed forces may move into the hills, or start attacking urban areas.

Rough terrain will decrease the effectiveness of any aerial strategy, but in particular it will affect modern aerial strategies. Despite new technologies, rough terrain heavily inhibits the ability of aerial attacks to detect targets (for example, electronic emissions can be detected even through rough terrain, but this is only helpful in targeting the emission itself) (S. Biddle 2004). As Stephen Biddle states, "the natural complexity of the Earth's surface is still sufficient to degrade aerial targeting when exploited properly" (S. Biddle 2004, 57). A non-modern aerial strategy will stress less discriminate bombing, and will focus on general destruction of the enemy. This means that even if the

opponent is concealing its forces and/or key support centers within a rough terrain, if the state carrying out the aerial campaign engages in an extensive-enough bombing campaign, it should be able to destroy at least some of the resources/troops of the opponent, if nothing else by sheer chance. Large-scale bombing will also serve to disorient the defenders, thereby disrupting their operations, even if the actual targets cannot be identified in the rough terrain. For example, in the early stages of the Vietnam war the United States used chemical defoliants (such as the well-known Agent Orange) to deny cover to opponents hiding their operations in jungle terrain, as well as to destroy the crops of and demoralize the opposition. This sort of non-modern campaign, which sought to starve out and demoralize the opponent, would not be a drastically affected by rough terrain.

In contrast, modern aerial strategies rely on being able to pick out key targets that will have a disproportionately large effect on the enemy's forces. If the terrain makes it more difficult to either identify or hit these targets, this means that the effectiveness of the modern strategy will decrease. If the enemy is concealed in mountains, for example, then traditional, less targeted forms of aerial attack (less discriminatory forms) become more effective relative to a targeted strategy. From this argument I derive hypothesis 3.2:

Hypothesis 3.2: When the adversary is fighting in rough terrain, the effectiveness of the modern system of air power will decrease, relative to the non-modern system.

We can also think about the nature of the adversaries against whom the air power is being used, and which characteristics make them more or less vulnerable to the use of

particular strategies against them. In particular, non-state actors may be less vulnerable to modern aerial strategies than traditional forces. Non-state actors have few key military targets that could be hit by a coercer, relying instead on guerrilla-type warfare (Byman, Waxman and Larson 1999, Horowitz and Reiter 2001). Without key military targets to hit, the modern system of air power may lose much of its effectiveness. Also, non-state actors often rely on low-technology systems of communication. While this can be a disadvantage to them in war-fighting, it also means that it is more difficult to disrupt their communications with a single (or a few) attack(s), as one would under the targeted system. We can thus derive hypothesis 3.3a:

Hypothesis 3.3a: When the adversary is a non-state actor, the effectiveness of the modern system of air power will decrease, relative to the non-modern system.

Of course, it may not be just the fact that the opponent is a non-state actor that leads to a decreased effectiveness of targeted aerial strategies, but rather the way in which the opponent is fighting. For example, the 2001 U.S. invasion of Afghanistan was technically against another state, Afghanistan, but the United States found itself fighting an opponent that fought in a non-traditional way, using guerrilla tactics and engaging in "terrorist" acts. Again, it may be the case that opponents that rely on guerrilla and other weak-actor types of warfare are missing these key centers of gravity that targeted aerial attacks seek to take advantage of. Because of this, I will include another hypothesis that refers to the use of unconventional warfare by the opponent:

Hypothesis 3.3b: When the adversary is engaging in unconventional warfare, the effectiveness of the modern system of air power will decrease, relative to the non-modern system

Data

The dependent variable used to test all of the hypotheses will be the outcome of the aerial campaign. In this case, the dependent variable will be whether the campaign was a success or not. This variable is derived from Allen's (2007) dataset, which includes a dichotomous variable that is coded 1 if the state that was carrying out the bombing campaign achieved the campaign's aims and 0 otherwise (in the research design chapter I describe this measure in greater detail).

The main independent variable will be a measure of how modern the aerial strategy is (this is the same measure that I used in the previous chapters and that I coded specifically for this project)[44].

[44] As mentioned earlier in this dissertation, I have identified the characteristics of modern and non-modern air power under each one of the three forms of air power (CAS, interdiction, strategic attack). I then design questions that identify the key characteristics of modern and non-modern air power, with each one being answered in the affirmative or negative. To provide an example, one of the questions under the modern interdiction section asks, "Are lines of communication and transportation (bridges, highways) being targeted?" (as I discussed before, targeting the lines of communication and cutting off the enemy's troops from their command and control is one of the key elements of the modern system). Under the non-modern interdiction section, a sample question reads, "Are combat forces (ie the actual troops, tanks, etc) being targeted?" (under the traditional, non-modern form of fighting the aim of attack is to destroy the actual troops so that they will no longer be able to resist).

The answers to these individual questions are then aggregated to form an overall index of how "modern" a particular use of air power is. In each case, only the answers from the dominant use(s) of air power are considered for that case's classification. Affirmative answers to questions related to the use of modern air power are added to the score, as are negative answers to the questions referring to the use non-modern air power. As the number of questions varies between categories, the "modern score" is normalized to a score between 0 and 1, which essentially represents the percentage of questions that indicate the use of the modern system. The higher that number is, the more modern that one particular case can be considered to be.

To test hypothesis 3.1, I will need a variable that indicates the military strategy that the opponent is using. As I stated earlier, I will focus on the opponent's military strategy on the ground. Besides being a better measure of what this hypothesis aims to understand, this also allows me to study those cases in which the opponent was not using air power. To measure the ground strategy of the opponent I use a variable that ranges from 0 to 2, with 0 being the least modern uses of ground power and 2 being the most modern ones. This variable is derived from newly-coded data by Matthew Knuth (Knuth 2012). Specifically, Knuth includes in his data two different variables that measure whether a state used a maneuver land strategy in its offense, defense, or both. The aggregate measure I use is coded 0 if neither strategy involved maneuver, 1 if either the offensive or defensive did, and 2 if both did[45]. While the modern system is not perfectly analogous to the distinction between maneuver and attrition (particularly because guerrilla warfare cannot fit under either category), there are some similar characteristics between the modern system and the maneuver strategy. This data also has the advantage of coding aerial and ground strategies separately, so that even if a maneuver strategy isn't perfectly analogous to the modern system I can still be confident that this measure is not "contaminated" by aerial strategies.

Hypothesis 3.1 makes specific reference to the effect that the opponent's ground strategy will have on outcomes when the targeted system of air power is being used in the air. This means that I will also be including an interaction between aerial strategies and the ground strategy of the opponent. Besides the variables about the ground strategy of the opponent, I will include a dichotomous variable that measures whether the opponent

[45] I added coding for the following campaigns, which were not included in the Knuth dataset: 1st and 2nd Russian-Chechen Wars, the French-Algerian War, the Tanker War, the Soviet-Afghan War, the Spanish Civil War, Operation Desert Strike and the Kurdish Revolt.

was using air power or not. This is a variable that I coded specifically for this project and that simply indicates the use of air power in combat by the opponent.

To test hypothesis 3.2 I will use a variable that indicates whether the terrain that the campaign is being carried out in can be considered "rough" terrain. This variable is coded using data from Fearon and Laitin's (2003) "Ethnicity, Insurgency, and Civil War." In this piece, Fearon and Laitin measure the proportion of a state that is mountainous. This measure does not take into account other types of terrain that could be favorable for hiding from an aerial attack (such as jungle or urban terrain), but is nonetheless a measure that is generally accepted within the IR literature. I use the terrain value for the state in which the aerial campaign was being carried out[46].

To test hypothesis 3.3a I use a dichotomous variable that is coded 1 if the target of the attack is a non-state actor. Those targets that are not considered a state under the Correlates of War Project state membership list in that given year are considered to be non-state actors (Correlates of War Project 2008).

Finally, to test hypothesis 3.3b, I need to determine whether the target of the attack is using unconventional tactics on the ground. In order to do this I again use Matthew Knuth's (Knuth 2012) dataset. The Knuth dataset includes a variable which measures force utilization and strategy at the military strategic level. Knuth's variable indicates whether the strategy involved conventional warfare only, conventional and unconventional warfare, unconventional warfare only, unconventional warfare and terrorism, or terrorism only. I aggregate these measures into a dichotomous variable that

[46] The Iran-Iraq War was fought on the border between the two states. Because of this, for bombing that did not involve the bombing of cities, I used an average of the terrain values for both states. In the case of the Spanish civil war, I used the value for Spain, for the Russian Chechen War I used the value for Russia and in any attacks against the PLO I used Israel's terrain value.

is coded 1 if either unconventional warfare or terrorism are used by the state that is the target of the aerial bombing campaign[47].

Analysis

Hypothesis 3.1 states that when the opponent is using a modern strategy on the ground, using a modern aerial strategy against it will be likely to lead to increased effectiveness and therefore to an increased probability of achieving success in the campaign. As mentioned before, the key to testing this hypothesis will be to look at the interaction between the aerial strategy of the state that is carrying out the bombing campaign and the ground strategy of its target. Note that I am not making the argument that a modern strategy will always lead to an increased probability of success, but rather that it will do so under a particular set of circumstances. In this case, the argument is that a modern aerial strategy will be more effective (than a non-modern aerial strategy), when it is being used against an opponent that is also using a modern strategy on the ground. Thus, the key variable in this analysis will be the interaction between the measure of how modern the aerial strategy of the state carrying out the aerial attack is and how modern its opponent's ground strategy is.

Because the dependent variable is a dichotomous one, whether the aerial attack was successful or not, I will use a logistic regression (logit analysis). Below, in table 7.1, I present the results of one model (Model 3.1a) that includes only the variables for how modern the attacker's aerial strategy is, how modern the opponent's ground strategy is,

[47] There were a few cases that were included in Allen's (2007) dataset that were not included in the Knuth dataset. I have coded this variable myself for the following cases: 1st and 2nd Russian-Chechen Wars, Israel vs. PLO 1970-1979, Soviet-Afghan War, Nigerian-Biafran War, Operation Wooden Leg, Tanker War, Operation Desert Fox, French-Algerian War, Kurdish Revolt, Britain vs. Somali Rebels, Operation Peace for Galilee, Operation Deliberate Force, Operation El Dorado Canyon.

and the interaction between the two variables and a second model (Model 3.1b) that includes a variety of control variables (explained earlier).

Table 7.1: Logit Analysis, the Effect of the Opponent's Strategy

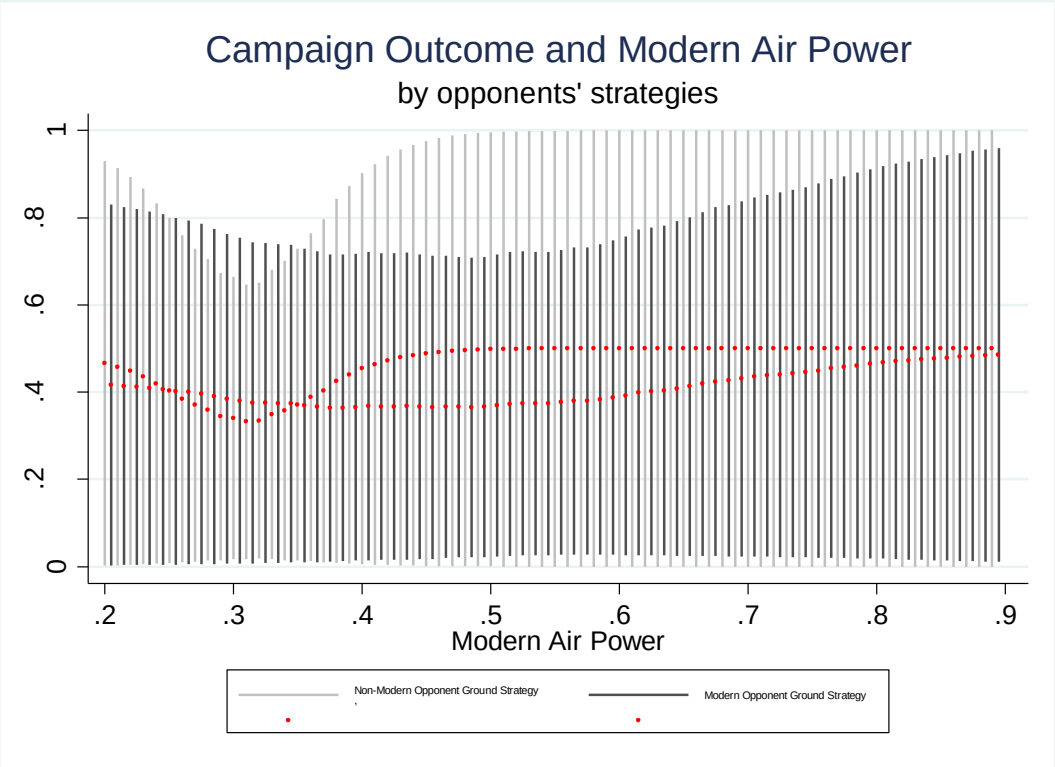
	Model 3.1a	**Model 3.1b**
Constant	-0.75 (1.21)	-1.29 (2.03)
Modern Air Power	0.69 (2.20)	2.60 (3.53)
Modern Ground Strategy (Opponent)	-0.51 (1.01)	-0.68 (1.12)
Interaction of Modern Air Power and Opponent's Modern Ground Strategy	0.82 (1.94)	0.61 (2.33)
Post 1950	---	-1.86 (1.51)
Post 1970	---	0.81 (1.52)
Power Ratio	---	0.02 (0.01)
Opponent's Use of Air Power	--	0.36 (1.19)
n	41	36
Log likelihood	-26.45	-22.04
LR chi2 (Prob> chi2)	0.95 (0.8143)	4.04 (0.7756)
Pseudo R2	0.0176	0.0839

We can see from the table above that in both models, with and without the control variables, the coefficient on the modern air power strategy is positive (meaning that it is more likely to lead to successful campaigns) and the coefficient on the use of modern ground strategies by the opponent is negative (meaning that it is less likely to lead to successful air campaigns). Most importantly, though, the interaction of the use of modern air power and the use of modern ground strategies by the opponent has a positive

coefficient. This seems to support hypothesis 3.1, which states that the modern uses of air power will be more effective against an opponent that is also using a modern strategy on the ground.

What is problematic about these results is the fact that despite the coefficients being in the expected direction, they are not statistically significant. One option, since I am focusing on an interaction variable, is to look at the substantive effects of changing the opponent's strategy from a non-modern strategy to a modern one. Below I present a graph in which I use Monte Carlo simulations to present these effects (King, Tomz and Wittenberg 2000). The x-axis represents how modern the aerial strategy being used in the campaign is (with higher values representing more modern strategies). The y-axis represents the probability of being successful in the campaign. In the graph the dots represent mean probabilities, with the lines representing the 90% confidence interval around that mean value. The light grey lines represent the cases in which the opponent's strategy was non-modern and the dark grey lines represent the cases in which the opponent's strategy was modern.

Figure 7.1: Campaign Outcome and Modern Air Power, by Opponents' Strategies



As we can see from the above figure, it is difficult to distinguish a significant substantive effect using this approach. A problem with this analysis may be the fact that we are dealing with such a small sample size. Because of this, it may be useful to simply look at some cross-tabulations between the outcome of the campaign and some key independent variables.

First of all, I look at the cross-tabulation between the campaign outcome and the use of modern air power by the state carrying out the campaign. In the table I present the number of cases, as well as the percentage of cases, by column (written in parentheses):

Table 7.2: Cross-Tabulation, Aerial Strategy and Outcome

	Non-Modern Air Power	Modern Air Power
Failure	21 (66%)	15 (65%)
Success	11 (34%)	8 (35%)

As we can see from the table above, 66% of the cases that use non-modern air power ended in failure, while 34% ended in success. Very similarly, 65% of the cases that used modern air power ended in failure and 35% in success. This is consistent with my previous statement that neither strategy will necessarily always be superior in conflict (which makes sense, as we observe states using both strategies).

I then look at the cross-tabulation between the campaign outcome and the use of modern strategies by the target state. In the table I present the number of cases, as well as the percentage of cases, by column (written in parentheses). I present percentages by column to represent the difference between the cases that ended in success and in failure, both in the cases in which a modern strategy was used and in those in which a non-modern strategy was used:

Table 7.3: Cross-Tabulation, Opponent's Ground Strategy and Outcome

	Non-Modern Ground Strategy (by opponent)	Modern Ground Strategy (by opponent)
Failure	10 (55%)	22 (73%)
Success	8 (45%)	8 (27%)

As we can see from the table above, 55% of the cases in which the opponent used a non-modern ground strategy ended in failure, while 45% ended in success. 73% of the cases in which the opponent used a modern ground strategy ended in failure and 27% in success. This would seem to show that, in general, modern ground strategies make it more difficult for a state to carry out an effective air campaign, independently of how that campaign may be carried out (this is consistent with Biddle's (2004) statement about the modern system being less vulnerable to aerial bombing).

Finally, I look at the cross-tabulation between the campaign outcome and the interaction between modern aerial strategies and modern ground strategies used by the opponent. In the table I present the number of cases, as well as the percentage of cases, by column (written in parentheses). I present percentages by column to represent the difference between the cases that ended in success and in failure, both in the cases in which a modern aerial strategy was used against a modern ground strategy and in those in which this was not the case:

Table 7.4: Cross-Tabulation, Aerial Strategy, Opponent's Ground Strategy and Outcome

	Modern Aerial Strategy + Modern Ground Strategy (by opponent)	Modern Aerial Strategy + **Non**-Modern Ground Strategy (by opponent)	**Non**-modern Aerial Strategy + Modern Ground Strategy (by opponent)	**Non**-modern Aerial Strategy + **Non**-Modern Ground Strategy (by opponent)
Failure	6 (75%)	5 (63%)	16 (72%)	5 (50%)
Success	2 (25%)	3 (37%)	6 (27%)	5 (50%)

As we can see from the table above, 65% of the cases in which the attacker used a non-modern aerial strategy and/or the opponent used a non-modern ground strategy ended in failure, while 35% ended in success. 75% of the cases in which the attacker used a modern aerial strategy against a modern ground strategy ended in failure and 25% in success. This would seem to show that, in general, modern ground strategies make it more difficult for a state to carry out an effective air campaign, though modern aerial strategies seem to work best against them. Still, we should be cautious when interpreting this result, as simply changing one of the values in the right column from a failure to a success would change this conclusion. It thus might be the case that modern ground strategies resist aerial attacks better, independently of how those attacks are carried out.

Hypothesis 3.2 states that when the opponent is fighting in rough terrain, the effectiveness of the modern system of air power will decrease (because it will become more difficult to identify and destroy key targets).

The dependent variable will again be whether the campaign was successful. The two key independent variables will be the terrain in which the attack is being carried out (measured using the Fearon & Laitin (2003) measure) and how modern the aerial attack is. As before, I am particularly interested in understanding the interaction between these two variables, which means that I will also include an interaction variable in the analysis.

Because the dependent variable is dichotomous, I will use a logistic regression (logit) analysis to test it. The first model (Model 3.2a) will simply include the three basic independent variables, while the second one (Model 3.2b) will also include some control variables. In particular, I will include measures of whether the attack was carried out post-1950 or 1970 (to reflect the effect of changing technology on the effectiveness of

aerial attacks) and the power ratio between the state carrying out the aerial campaign and its target.

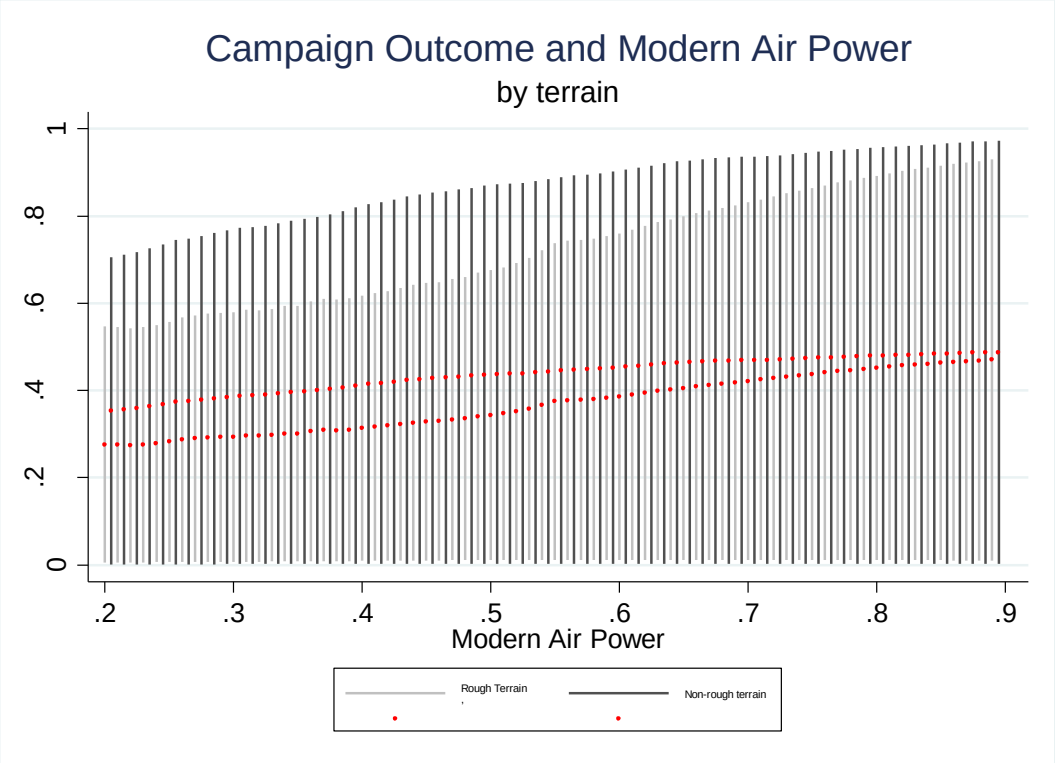
Table 7.5: Logit Analysis, the Effect of Terrain

	Model 3.2a	**Model 3.2b**
Constant	-0.49 (1.04)	-1.22 (1.20)
Modern Air Power	0.17 (2.03)	2.63 (2.81)
Rough Terrain	-0.05 (0.07)	-0.01 (0.08)
Interaction of Modern Air Power and Rough Terrain	0.05 (0.14)	-0.11 (0.17)
Post 1950	---	-2.55 (1.77)
Post 1970	---	1.49 (1.73)
Power Ratio	---	0.04 (0.02)
n	48	40
Log likelihood	-29.62	-21.92
LR chi2 (Prob> chi2)	1.87 (0.5999)	7.96 (0.2413)
Pseudo R2	0.0306	0.1536

As we can see from the above results, once we take into consideration the control variables, the coefficient on the interaction term between modern aerial campaigns and rough terrain is negative, meaning that the combination of the two is likely to lead to decreased probability of victory through aerial campaigns. This is true despite the fact that the coefficient on the targeted aerial campaigns alone is positive. A problem with these results, of course, is that they do not achieve statistical significance. Also, as we are again dealing with interactions, it is important to look at substantive effects as well.

Below I present a graph in which I again use Monte Carlo simulations to present these effects (King, Tomz and Wittenberg 2000). The x-axis represents how targeted the aerial strategy being used in the campaign is (with higher values representing more modern strategies). The y-axis represents the probability of being successful in the campaign. In the graph the dots represent mean probabilities, with the lines representing the 90% confidence interval around that mean value. The light grey lines represent the cases in which the value for the terrain in which the conflict was being fought on is set at the mean and the dark grey lines represent cases in which the value is increased by one standard deviation.

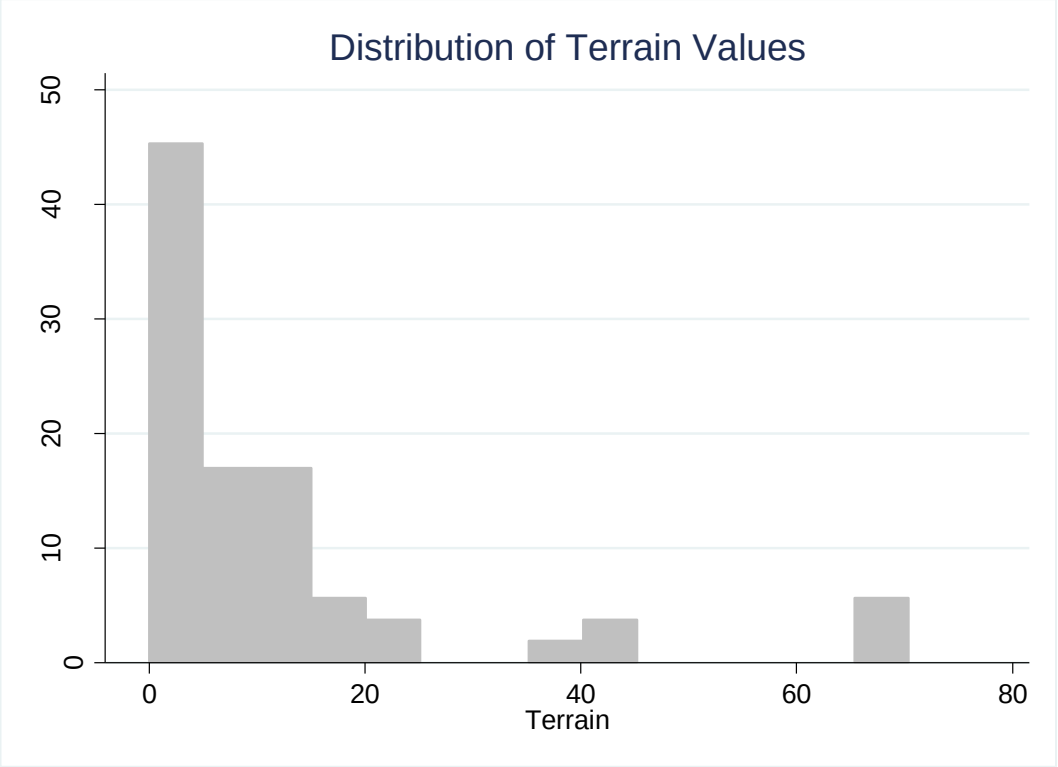
Figure 7.2: Campaign Outcome and Modern Air Power, by Terrain



As we can see from the above figure, it is again difficult to distinguish a significant substantive effect using this approach. I will thus again look at the cross

tabulations between outcome and the terrain variables (as I have already shown above the cross-tabulation between outcome and the targeted air power variable). In order to do this, I will use a dichotomous measure of terrain. I will thus create a variable that is coded 0 is the value for the terrain variable is less than the median value of 6 and one otherwise. As we can see from the histogram below, it seems that the cases are somewhat evenly distributed on either side of the median (the mean value is about 12).

Figure 7.3: Distribution of Terrain Values



I begin by looking at the cross-tabulation between the campaign outcome and the terrain in which the campaign was carried out. In the table I again present the number of cases, as well as the percentage of cases, by column (written in parentheses). I present percentages by column to represent, the difference between the cases that ended in

success and in failure, both in the cases in which the terrain was rough and in which it was not:

Table 7.6: Cross Tabulation, Terrain and Outcome

	Non-Rough Terrain	Rough Terrain
Failure	21 (70%)	11 (61%)
Success	9 (30%)	7 (39%)

As we can see from the table above, in the case in which the terrain is not rough, 70% of the cases are failures, whereas 30% of them are successes. In the case of the terrain being rough, a slightly higher percentage of the cases (39%) are successes. It would appear that the cases with rough terrain have more successful aerial campaigns, though switching over two cases from failure to success would make the relationship change.

The variable that matters the most, though, is the interaction between the modern use of air power and rough terrain. Below I present the cross-tabulation between these two variables:

Table 7.7: Cross Tabulation, Aerial Strategy, Terrain and Outcome

	Modern Aerial Strategy AND Rough Terrain	Non-modern Aerial Strategy AND Rough Terrain	Modern Aerial Strategy AND Non-rough terrain	Non-modern Aerial Strategy AND Non-rough terrain
Failure	3 (50%)	9 (64%)	6 (75%)	12 (67%)
Success	3 (50%)	5 (36%)	2 (25%)	6 (33%)

In this case there seems to be a lack of support for hypothesis 3.2, as the combination of rough terrain and modern aerial strategies has a higher percentage of successes than cases in which this combination does not occur. Part of the reason that this may be happening is that the Fearon and Laitin (2003) variable measure only mountainous terrain, while the theory predicts that any sort of rough terrain (including urban or jungle) should make it more difficult to use the targeted system of air power.

Finally, I turn to testing hypotheses 3.3a and 3.3b. Hypothesis 3.3a states that the effectiveness of the modern system will decrease when it is being used against a non-state actor. Note that this hypothesis is referring to the interaction of the modern air power variable and the non-state actor variable. In other words, it is not stating that either the modern system or the opponent being a non-state actor will make success less likely, but rather that the combination of the two will lead to decreased effectiveness and therefore to a lower probability of achieving success in the campaign.

In this case, the dependent variable will again be whether the campaign was a success or not (from Allen's (2007) dataset)

The main dependent variables will be a measure of how modern the aerial strategy is (this is the same measure that I used in the previous chapters and that I coded specifically for this project). I will also include a variable that measures whether the target is a non-state actor. Of course, as I stated before, it will really be the interaction of these two variables that will be the key variable in this analysis and in the testing of hypothesis 3.3a.

As a control variable, to represent the advantage that stronger attackers have in conflict, I will include a variable that measures whether the attacker has greater capabilities than the target of the bombing campaign. The variable is coded dichotomously, with 1's representing cases in which the state carrying out the attack is stronger than its target. This is of course to consider the idea that an attacker that is much stronger than its target is more likely to achieve its aims in the bombing campaign, regardless of the military strategy that it may be using[48]. To determine which of the two states is stronger, I compare their CINC (Composite Index of National Capability) scores (Singer, Bremer and Stuckey 1972, Singer 1987). This of course is a surrogate measure, which measures the industrial capabilities, population and military personnel/expenditures of states. Still, the CINC score is a widely used measure that is generally accepted as a measure of military power[49].

[48] Using the power ratio in this regression causes the variables for non-state target and the interaction between non-state target and targeted air power to be omitted, as the power ratio variable is perfectly correlated with the non-state target variable.

[49] To potentially better measure military might, I also tried the analysis using only the military expenditures measure to compare to military power of both states. This generated very similar results to the analysis that used the CINC score as a measure of power.

I will also include a post-1950 control variable, to represent the possibility that as weapons systems became more sophisticated they increased the effectiveness of aerial campaigns. I will also include a post-1970 control variable to represent the first uses of smart bombs, allowing for the possibility that this new technology may have affected the duration of aerial campaigns[50]. In the table below, the first model, Model 3.3aa, will include only the first three independent variables, while the second model, Model 3.3ab, will include the control variables.

Table 7.8: Logit Analysis, the Effect of Non-State Targets

	Model 3.3aa	**Model 3.3ab**
Constant	-1.37 (0.85)	-2.02 (1.15)
Modern Air Power	1.51 (1.62)	2.87 (2.15)
Non-State Target	11.16 (9.35)	12.24 (9.90)
Interaction of Modern Air Power and Non-State Target	-23.95 (20.59)	-24.57 (21.03)
Post 1950	---	-1.35 (1.25)
Post 1970	---	0.28 (1.27)
Weaker Target	---	0.78 (0.92)
n	48	48
Log likelihood	-28.51	-21.92
LR chi2 (Prob> chi2)	4.08 (0.2529)	7.96 (0.2413)
Pseudo R2	0.0668	0.1536

[50] As mentioned in the research design chapter, I tried using a few different dates (such as 1945 or 1973) to define this variable and obtained similar results.

As we can see in the above table, in both models the interaction variable between the target being a non-state actor and the use of a modern aerial strategy has a negative coefficient. This would appear to support the proposition that the combination of a non-state actor and the use of the modern system leads to a decreased probability of achieving the ends of the bombing campaign (which I argue is because of the decreased effectiveness of the modern system of air power when it is being used against a non-state actor). The problem, of course, as we can see from this table, is that the coefficients are again not significant.

Another possibility to consider is of course that it may not be the fact that the target is a non-state actor that matters, but that it is using unconventional methods of war. Below, I present the results of a similar model that substitutes a measure of whether unconventional methods of war were used for the variable that measures whether the target was a non-state actor. I again include a model with only the main independent variables (Model 3.3ba) and one that includes the same control variables as in the previous two models (Model 3.3bb).

Table 7.9: Logit Analysis, the Effect of Unconventional Targets

	Model 3.3ba	**Model 3.3bb**
Constant	-1.02 (1.20)	-1.35 (1.29)
Modern Air Power	1.06 (2.25)	2.56 (2.74)
Unconventional Target	0.16 (1.64)	-0.20 (1.76)
Interaction of Modern Air Power and Unconventional Target	-0.82 (3.12)	0.30 (3.46)
Post 1950	---	-1.55 (1.43)
Post 1970	---	0.26 (1.33)
Power Ratio	---	0.01 (0.01)
n	47	39
Log likelihood	-29.96	-24.04
LR chi2 (Prob> chi2)	0.36 (0.9477)	2.85 (0.8275)
Pseudo R2	0.0060	0.0560

As we can see from the table above, in the model that includes no control variables, the coefficient on the interaction variable (modern air power being used against an opponent that is using unconventional methods of war) is negative, as hypothesis 3.3b predicts, but it sign switches to positive once the control variables are included. Also, the coefficients are again not significant.

Again, since the key variables that I am interested in are interactions, it is also important to graph the substantive effects. As before, I again use Monte Carlo simulations to present substantive effects (King, Tomz and Wittenberg 2000). In the following graphs, the x-axis represents how modern the aerial strategy being used in the campaign is (with higher values representing more modern strategies). The y-axis

represents the probability of being successful in the campaign. In the graph the dots represent mean probabilities, with the lines representing the 90% confidence interval around that mean value. The light grey lines represent cases in which the target was a non-state actor (or was fighting using unconventional war) and the dark grey lines represent cases in which the target was a state actor (or was fighting using conventional methods).

Figure 7.4: Campaign Outcome and Modern Air Power, for State and Non-State Opponents

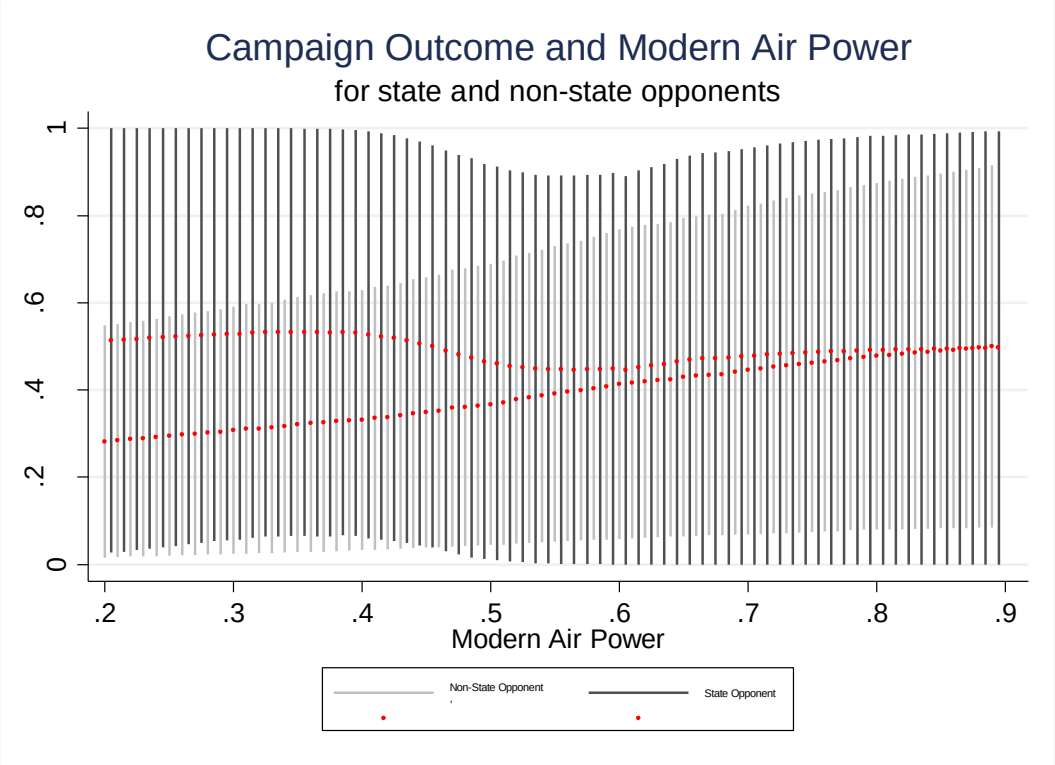
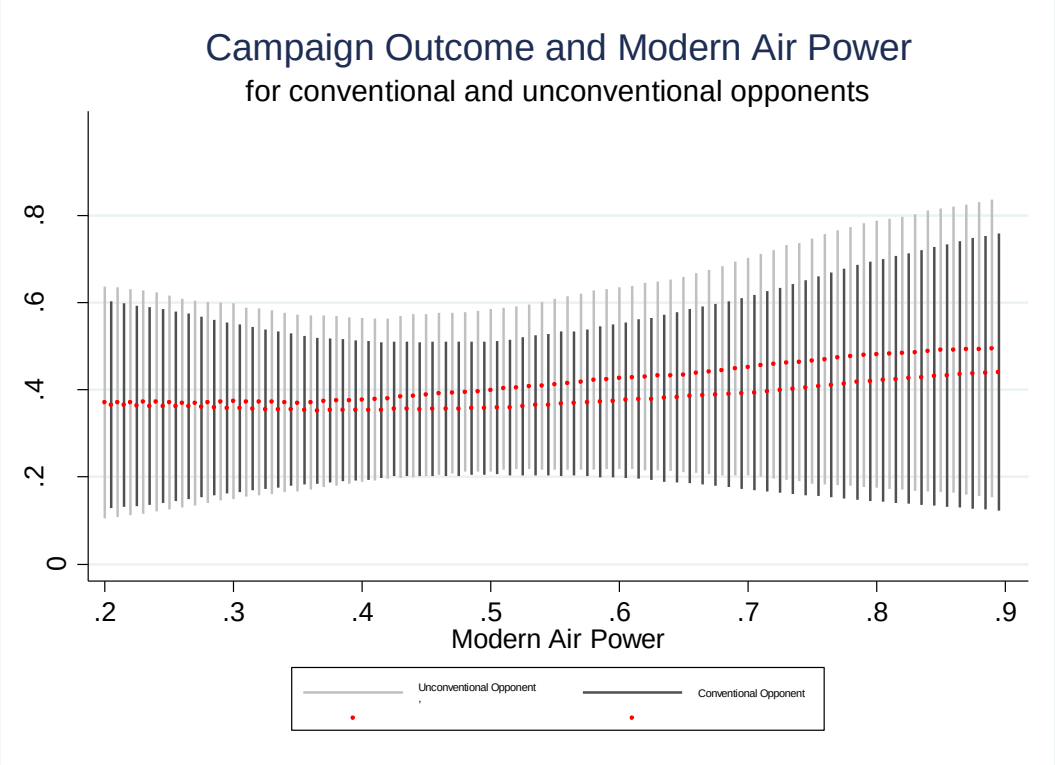


Figure 7.5: Campaign Outcome and Modern Air Power, for Conventional and Unconventional Opponents



From the two previous figures, it is again difficult to distinguish a significant substantive effect using this approach. I will thus again look at the cross tabulations between outcome and the non-state actor/unconventional war variables (as I have already shown above the cross-tabulation between outcome and the modern air power variable).

I begin by looking at the cross-tabulation between the campaign outcome and whether the opponent was a non-state actor. In the table I again present the number of cases, as well as the percentage of cases, by column (written in parentheses). I present percentages by column to represent, the difference between the cases that ended in success and in failure, both in the cases in which the target was a non-state actor and in which it was a state actor:

Table 7.10: Tabulation, State or Non-State Targets and Outcomes

	State Target	Non-State Target
Failure	27 (66%)	5 (71%)
Success	14 (34%)	2 (29%)

In this graph, the cases in which the aerial campaign is being carried out against a state actor are 66% failures, whereas the campaigns carried out against non-state actors are 71% failures. While the percentage is higher in the case of non-state actors, the difference is minimal.

I now turn to a cross-tabulation between outcome and cases in which modern air power is being used against a non-state actor:

Table 7.11: Tabulation, Aerial Strategy, Non-State Targets, and Outcome

	Modern Aerial Strategy AND Non-State Target	Non-Modern Aerial Strategy AND Non-State Target	Modern Aerial Strategy AND State Target	Non-Modern Aerial Strategy AND State Target
Failure	3 (100%)	2 (50%)	8 (62%)	19 (68%)
Success	0 (0%)	2 (50%)	5 (38%)	9 (32%)

The percentages on this table seem to show that failure is indeed much more likely when a Modern aerial strategy is used against a non-state actor. Of course, as the cases of targeted aerial strategies being used against non-state actors are so few, this result would likely not be very stable.

We can do similar cross-tabulations for the case in which the opponent is using unconventional modes of war-fighting:

Table 7.12: Tabulation, Unconventional and Conventional Targets and Outcomes

	Conventional Target	Unconventional Target
Failure	10 (63%)	21 (68%)
Success	6 (37%)	10 (32%)

As we can see in the table above, the is no difference in the percentage of campaigns against conventional targets that end in defeat (63%) and the percentage of campaigns against unconventional targets that end in defeat (68%). Thus, I do a similar cross-tabulation for the cases in which it is specifically modern aerial strategies that are used against an opponent that is using unconventional methods of war-fighting:

Table 7.13: Tabulation, Aerial Strategy, Unconventional Targets, and Outcome

	Modern Aerial Strategy AND Unconventional Target	Non-Modern Aerial Strategy AND Unconventional Target	Modern Aerial Strategy AND Conventional Target	Non-Modern Aerial Strategy And Conventional Target
Failure	8 (71%)	13 (65%)	3 (60%)	13 (65%)
Success	3 (27%)	7 (35%)	2 (40%)	7 (35%)

In this case, the percentage of failures when using the targeted system of air power against an unconventional target is higher than in other aerial campaigns. Again,

though, because the number of cases is small, the result will not be stable if the one of the cases is changed from failure to success.

Conclusion

This chapter took into account the characteristics and strategy of the opponent when evaluating the effectiveness of aerial strategies. While the small sample size makes it difficult to draw conclusions from this set of results, this chapter does give us some idea of what are some concepts that are worthy of further exploration. For example, it appears to be the case that modern strategies on the ground are in general more resistant to aerial attacks. That being said, there does seem to be some evidence that the more effective aerial strategy against a modern ground strategy will be another modern strategy.

Still, targeted aerial strategies do not appear to be very effective against non-state actors or actors using unconventional methods of war-fighting. While the evidence for this claim is somewhat weak, it is an argument that could be further explored through case studies, for example.

There does not appear to be much evidence for targeted aerial campaigns being less effective against opponents that are fighting in rough terrain. As stated earlier, though, this might be because the theory refers to all types of rough terrain, while the operationalization of terrain takes only mountainous terrain into account.

CHAPTER 8: CONCLUSION

This dissertation project began with the premise that there is no ideal aerial strategy that will lead to greater effectiveness in all circumstances, but rather that different aerial strategies will be more effective in different types of conflict. Thus, its largest contribution was to explore how different aerial strategies perform under actual bombing campaigns, taking into account the actions of ground troops, as well as the general characteristics of the conflict. I not only considered how aerial strategies could affect the outcome of the conflict (viewed as either success or defeat), but also how they influence how the conflict played out, particularly considering how aerial strategies affect the duration of bombing campaigns.

Data Contribution

Independently of the analysis, one major contribution of this project was the data collection, which not only added new information on aerial bombing campaigns to available data sources, but also derived a new classification of aerial strategies based on characteristics that go beyond the identification of a target as either military or non-military. Deriving this new classification created a need to classify and collect data on both aerial and ground strategy, which I have done in this project. By making this data (and the coding scheme) publicly available I believe that I will allow researchers whose research question requires them to look beyond the identification of a target as either military or civilian.

To study the effectiveness of aerial strategies, I needed a way to categorize them. The categorization I developed in this project was based on Stephen Biddle's (2004) modern system of force employment as well as John Warden's discussion (2000) of centers of gravity. I distinguished between modern and non-modern uses of air power. The unit of analysis was the aerial campaign, which is defined as "A series of related major operations aimed at achieving strategic and operational objectives within a given time and space" (Department of Defense 2012). Modern uses of air power are those campaigns that are more targeted, and in which the aim of the campaign is not to destroy the opponent, but rather to disrupt its operations for a long-enough period of time in order to exploit this opportunity and achieve the campaign's aims.

In creating the coding scheme I distinguished between three different uses of air power: close-air support, interdiction and strategic attack[51]. For each use of air power I created a set of questions that could be answered in either the affirmative or negative. I then aggregated these responses (for the particular use of air power that was employed in each campaign) into a single measure of how "modern" the use of air power in that

[51] Air interdiction refers to air operations conducted to divert (divert enemy forces from the places where they are most needed, or to more vulnerable areas), disrupt (disrupt command and control, intelligence, transportation, supply lines and psychological will), delay (delay to gain time for friendly forces, to pressure the opponent to attempt urgent movement, or to maintain the initiative), or destroy (destroy enemy forces and supplies, or create the perception of imminent destruction) the enemy's military potential before it can be brought to bear effectively against friendly forces, or to otherwise achieve objectives (Air Force Basic Doctrine 2003).
To define close air support I use the Department of Defense Dictionary's definition: Air action by fixed and rotary-wing aircraft against hostile targets that are in close proximity to friendly forces and that require detailed integration of each air mission with the fire and movement of those forces. The proximity of close air support to friendly forces is not defined by actual distances, but rather by a "range within which some form of terminal attack control is required for fratricide prevention" (Counterland Operations 2006). Strategic attack can be defined using the United States Air Force's Basic Doctrine, which states that strategic attack is "offensive action conducted by command authorities aimed at generating effects that most directly achieve […] national security objectives by affecting the adversary's leadership, conflict-sustaining resources, and strategy" (200340). We can also refer to the US Strategic Bombing Survey, which states that ""strategic bombing […] is aimed at the systematic destruction of those resources which will most weaken the enemy by denying him the materials or weapons he needs to prosecute the war" (US Strategic Bombing Survey, Jan 1947, p.2, pt. 2). The USAF Basic Doctrine best sums up strategic attack in noting that it is about attacking the enemy as a system, not just on the field.

campaign was. There were two major advantages to using this approach for coding the data (rather than just identifying each use as either modern or non-modern). The first was that it allowed me to have a continuous measure of how modern the use of air power is. This fits well with the theory used in this project, as I have argued that most uses of air power (if not all) are a combination of modern and non-modern elements. The second advantage was that this approach helped to protect me against having my previous impressions of the campaigns bias my coding. Answering specific questions one at a time allows me to be more objective in my coding, and to have to base myself on historical accounts or primary documents, rather than my own previous impressions. Using this approach also meant that it would be easier for others using the data to decide to use only some of the questions in creating an index and/or to choose a different weighting scheme than I did.

Most of the existing datasets that include categorization of ground strategies (for example, those that distinguish between maneuver, attrition and punishment strategies) appear to take into account aerial strategies as well. Since I wanted to study the impact of air power separately from ground power, the existing dataset were not appropriate for my research[52]. The creation of a ground strategy variable which distinguished between a range of modern and non-modern aerial strategies, followed an analogous process to the creation of the air power variable and had the added advantage of allowing me to compare the two strategies on the same terms.

[52] Note that in Chapter 7, to measure the ground strategy of the opponent, I used a dataset created by Matthew Knuth (2012). Unlike previous datasets, this one does distinguish between military strategies on the ground, air and sea. This dataset, though, is very recent and was not complete at the time I was considering datasets to use in measuring the ground strategy that the state carrying out the aerial campaign was using.

This project represented a first draft of the dataset that classified different strategies of air power. While I felt comfortable analyzing these present data, in the future I would like to expand it to include a more detailed operational definition of modern and non-modern air power. A more detailed operational definition should also help with potential problems of reliability of the data (as this would leave less room for ambiguity when conducting the coding).

Military Doctrines and Aerial Strategies

Before studying the effect of aerial strategies on the durations or outcomes of campaigns, I had to address the possibility that states would simply choose their aerial strategy based on the characteristics of their opponents. This would result in a strong selection bias. If states optimized their aerial strategy based on the characteristics of their opponents, any results on the effect of aerial strategies on the outcomes of aerial campaigns (or conflicts) would not be generalizable to other cases.

If this alternative was correct then air strategy choice would be predicted by the characteristics of the opponent. The alternative idea I suggested was that military doctrines are more likely to have an effect on aerial strategy selection than are the characteristics of the conflict or opponent that the state is fighting. In order to consider these two possibilities, I conducted an empirical test that asked the question of whether the characteristics of the opponent predict strategy choice. I compared two different models, one that included only some control variables (such as time and the capabilities of the attacker) that would be expected to affected the choice of aerial strategies and another that included the characteristics of the opponent. After conducting the analysis

using both of these models, I conducted a likelihood ratio test to compare the fit of the two models. The results showed that the model that included the characteristics of the opponent added very little value to the model that included only the control variables.

The results seems to lend support to the idea that states do not modify their aerial strategies for every new conflict that they fight. Of course, this was a null finding, and not necessarily evidence that it was military doctrines that drove strategy choice. Because of this, I went on to do some additional work. I also conducted a qualitative comparison of the aerial strategies of the United States in Vietnam and the Soviet Union in Afghanistan. These were cases of two major powers, whose capabilities are reasonably close to each other (within this sample), fighting in similar time periods against foes that, by the metrics being used, looked similar to each other. At the same time, there were vast differences in the military doctrines of both the US and the USSR, with the American doctrine placing a much stronger emphasis on the modern style of air power. I argued that if states really were to choose the "best" possible aerial strategy for each conflict, then the United States and the Soviet Union should have chosen similar strategies. Instead, it appears to be the case that both the U.S. and the USSR chose aerial strategies that were different from each other, and in line with their respective military doctrines.

In the future, I would like to further explore the question of how it is that states select their military strategies. This would entail building an actual model of strategy choice that incorporated military doctrine as a factor that can affect military strategies. Testing this model would require obtaining data on what the military strategies of states were. The collection of these data would be useful in understanding the link between

doctrine and strategy, as it would allow me to test the hypotheses on aerial strategy selection directly.

Air and Ground Strategies

As stated earlier, one of the major contributions of this dissertation was to study air power in conjunction with ground forces. While air-only campaigns are interesting and have received much attention from the media, it is also true that most air campaigns also include some sort of ground component. The next step in this project was thus to understand how the presence of ground troops can affect what happens during an aerial bombing campaign. So, for example, how would the aerial campaign in Libya been different if NATO had also included ground troops in their intervention? Would it have concluded faster due to the added advantage of combined arms? Would NATO have lost the option of a quick victory?

I considered how the interaction of ground troops with an aerial campaign would affect its duration. In an era when air power is advocated based in part on its ability to achieve quick and easy victories, I was interested in comparing what the durations of campaigns that used ground troops were, compared to air only campaigns. In particular I was interested in observing whether different types of aerial campaigns (modern and non-modern ones) reacted differently to the introduction of ground troops.

I made the argument that modern aerial campaigns should have shorter durations than non-modern campaigns. Because modern air campaigns are considered to be riskier (S. Biddle 2004), they should lead to either overwhelming victories or overwhelming

defeats[53]. In contrast, the less risky non-modern strategies should lead to victories or defeats that are not overwhelming. I then argued that in the overwhelming victories or defeats, as it is obvious that one side will prevail over the other, campaigns should have shorter durations. Thus, my first hypothesis expected the duration of modern aerial campaigns to be shorter than the duration of non-modern aerial campaigns.

Of course, this did not yet take ground forces into account. I argued that ground forces serve the following three main purposes, when it comes to their interaction with air power:

1. Increased effectiveness of the aerial campaign, due to the combined arms approach
2. Target identification
3. Post-bombing assessments

All three of these roles should contribute to shorter campaigns. In their intelligence roles, ground troops allow air power to destroy targets more accurately without having to re-bomb areas (which saves time and resources). In the combined forces role, ground troops contribute to increased effectiveness of the campaign, which should lead to shorter campaigns. Thus, I also included a second hypothesis which stated that aerial campaigns that involve ground troops should be shorter than those that do not.

Up until this point, I had considered only a dichotomous measure of whether ground troops were present or not. Of course, in order to understand the interaction of aerial and ground troops, it was also important to consider the strategies of the ground

[53] Note that when I talk about overwhelming defeats I don't necessarily mean that one side had to incur very heavy military casualties and be completely overwhelmed by a stronger opponent (though this would certainly fall into the category of an overwhelming defeat), but also refer to cases in which a campaign fails in its objective and it becomes obvious to the attacker state that this approach will not serve to achieve its aims. In other words, cases in which the state chooses to "cut its losses" and give up on the aims.

troops. Thus, I also explored whether the military strategy that the ground troops were using mattered towards the expected duration of the aerial campaigns. The first possibility that I considered was that modern aerial strategies, when combined with modern ground strategies, would lead to shorter aerial campaigns. This was because modern aerial strategies do not necessarily rely on destroying the opponent, but rather on opening up windows of opportunity that, if properly taken advantage of, could lead to the collapse of the opponent's forces. In order for ground troops to be able to take advantage of these windows of opportunity, it may be necessary for them to be operating under a similar way as the air power. In other words, their strategy should emphasize momentum and surprise, elements that will take full advantage of these opportunities.

The other possible explanation would be that ground troops serve mostly an informational role (that of gathering intelligence on target locations and post-bombing assessment) when it comes to aerial campaigns. Thus, independently of their military strategy, they should lead to shorter aerial campaigns. I considered the possibility that the strategy of ground troops would affect the duration of the conflict as a whole, but that when it came to the duration of aerial campaigns, the strategy of the ground troops would not affect its duration.

I found that modern aerial campaigns did indeed appear to have a shorter average duration than non-modern aerial campaigns. The presence of ground troops also appeared to contribute to shorter durations, but what was particularly interesting was the interaction of these two variables. Rather than having a uniform effect across the different uses of air power, the effect of ground troops varied depending on how modern the aerial strategy at use is. In cases of non-modern military strategies, adding ground

troops contributed to shorter campaigns. Thus, it appeared that in these cases, as the hypothesis predicted, ground troops served to compensate for some of the shortcomings of the air power, leading to shorter campaigns.

In the case of the most modern uses of air power, though, the presence of ground troops led to longer campaign durations. A tentative explanation for this observation may be that in these most modern of cases, states were losing the option of coming in quickly, bombing a key target, and getting out as soon as possible. Once ground troops are brought in, evacuating them becomes more complicated than simply asking aircraft to turn around. Thus, this may add logistical complication will add to the duration of the campaign.

This relationship held even when I conducted the analysis using a competing risks model, distinguishing between cases that ended in success and ones that ended in defeat. Ground troops, rather than having a single effect on the duration of aerial campaigns, instead seemed to moderate the duration, with mean values being more constant throughout the different uses of air power. This was an interesting finding, as it helps us to understand what effect the introduction of ground troops might have on different types of aerial campaigns. In the case of the most modern campaigns, adding ground troops increased the duration, whereas in the case of the least modern campaigns, ground troops shortened it.

When it comes to the strategy of the ground troops that were being used in conjunction with air power, my results seemed to support the proposition that it is the presence of ground troops, rather than the actual strategy that they are using, that affects the duration of aerial campaign. Distinguishing between modern and non-modern uses of

ground power does not appear to make a difference in determining the duration of aerial campaigns. Again, here I would like to reiterate that at this point I studied solely the duration of air campaigns, not of the conflict as a whole. It may of course be the case that the strategy of the ground troops matters in determining the duration of the conflict as a whole, but not of the aerial campaign[54].

A further avenue for research is to consider whether there is something unique about campaigns that include ground troops that can affect their duration. It may be the case that the air campaigns which also include a ground component are those in which the state conducting the aerial attack has more "resolve." Of course, the term "resolve" has tended to be used generally and vaguely, and the challenge would be to find a measure of resolve that is independent of the outcome of the conflict and the presence of ground troops.

The main contribution of this chapter was to explain how different uses of air power affect how aerial campaigns will play out, particularly referring to how long they will last. It did so for both cases of success and defeat, as well as taking into account the role that ground troops play in determining how the campaign will develop.

The Opponent

I did not find much support for the possibility that the characteristics of the opponent determine the strategy choice of the state carrying out the aerial campaign. That being said, this does not mean that the characteristics of the opponent will not affect the outcome of the campaign. Thus, while earlier I focused on decisions made by the

[54] Another issue with this analysis might be the fact that in this case all of the cases of air-only campaigns have to be dropped, reducing an already small sample. This makes it more difficult to conduct "large-N" empirical analysis on the data.

state carrying out the aerial campaign and how they affect the duration of the campaign, I then moved on to focusing on how the characteristics and strategies of the opponent affect the outcome of the campaign.

In particular, I studied how the effectiveness of different aerial strategies (modern and non-modern ones) is affected by both the strategy and the characteristics of the opponent. Because I argued that these characteristics do not determine the strategy choice of the state carrying out the aerial campaign, I found it possible to conduct this analysis. If the strategy choice of the state was not determined by the characteristics of the particular conflict (or opponent) I could study its effects on the outcomes. In this analysis, the dependent variable was the outcome of the aerial campaign (coded as either a success or a defeat, depending on whether the aims of the campaign were achieved).

I began by considering the military strategy of the opponent. Biddle (2004) argues that in general, modern ground strategies are less vulnerable to aerial attacks. I thus made the argument that the most effective way to conduct an aerial campaign against a modern ground strategy was to use a modern aerial strategy (Biddle also argues that the best way to counter modern defenses is through another modern attack). The first hypothesis from this section stated that modern aerial strategies will be more effective against modern ground strategies than non-modern aerial strategies.

Besides the strategy chosen by the opponent, I also considered the characteristics of the opponent, and of the conflict itself. One possibility that I considered was that modern aerial attacks, which rely on the identification and destruction of key targets that are expected to have repercussions throughout the system, would be less effective against non-state actors. This would be the case because non-state actors are less likely to have

these types of key targets, and if they do not exist then they cannot be bombed. It is also a possibility that opponents that fight like non-state actors, using guerrilla and unconventional warfare, may be less vulnerable to these types of attacks, for the same reasons as non-state actors would be. The next two hypotheses thus stated that modern aerial attacks would be less effective against non-state actors or actors fighting in unconventional ways.

Finally, I considered whether the area in which the conflict is being fought affects the effectiveness of different aerial strategies. In particular, I considered whether rough terrain may make it more difficult to carry out targeted, modern strategies, as it becomes more difficult to identify key targets when they terrain is rough. Rough terrain will not be as large of a problem in the case of more indiscriminate bombing that does not rely as heavily on the identification of particular targets. The final hypothesis thus stated that modern aerial attacks would be less effective under rough terrain.

I found limited support for most of these hypotheses. While the signs of the coefficients in the analysis were mostly in the expected directions, they lacked statistical significance. This might have to do with the limited number of cases, or with the need for more specific data that better operationalizes the variables in question. I believe that to continue studying this question in the future I may need to engage in further data collection or use more detailed cases studies.

Another avenue for future study may be to distinguish between cases of close-air support, interdiction, and strategic attack. It may be the case that the effect of aerial strategies on the outcomes of aerial campaigns (and of conflict) may be different for each one of these uses of air power. For example, there is much evidence that shows that

strategic bombing of population centers (which would be considered non-modern) is ineffective (Pape [1996], to cite one example). Yet we can easily imagine cases in which non-modern interdiction may be more effective than modern interdiction (for example, when fighting guerrilla fighters in rough terrain). This means that the lack of clear results on the effectiveness on different strategies of air power may have resulted from not drawing a distinction between these cases. In the future I would also be interested in studying whether strategy changes during a campaign or across multiple campaigns in the same war. This would allow me to consider the possibility that states may adapt to each other during a conflict, changing their aerial strategies to best respond to each other.

The Project

Overall, this project's contribution was to provide a deeper understanding of the different ways in which air power can be used, and how that will affect aerial campaigns. This project challenged us to draw finer distinctions in the use of air power, and to ask how they may lead to different outcomes of aerial campaigns.

This project also took into account ground forces. There are few pieces in the quantitative international relations literature that consider both ground and air strategies (of the state carrying out the aerial attack and of its opponent), yet we know that states consider both attacks in the air and on the ground when making decisions in war. I believe that this project will help to move the study of air power in a direction that takes into account its interaction with ground forces, as well as different ways in which air power can be utilized. By studying military strategies holistically we can move closer to an understanding of the actual exchange of information that takes place on the battlefield.

Throughout this chapter I have mentioned various questions that have been brought up by this project. Some of them were motivated by unexpected results and others are simply the natural extension of the current conclusions. The nature of science is often to generate more questions rather than answers, and so these new questions are part of the project's contribution. These questions, along with the conclusions, will hopefully help to motivate further studies on the effectiveness of air power in conflict.

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Appendix A: Raw Data

Variable	Campaign name	Campaign number	War name	COW War ID	Attacker	Attacker COW ID	Target	Allen date	Target COW ID
Variable Name	Campaign	CampaignID	War	WarID	Attacker	AttackerID	Target	date	TargetID
	Bombing of Dresden		World War II	15	Allies	2	Germany	1945	255
	Operation Peace for Galilee		1982 Lebanon War	37	Israel	666	PLO	1982-1985	.
	Operation El Dorado Canyon				United States	2	Libya	1986	620
	Blitz		World War II	13	Germany	255	Britain	Aug. 1940	200
			Gulf War	47	Iraq	645	Israel	1991	666
			World War II	11	USSR	366	Finland	1939-1940	375
	Operation Wooden Leg			36	Israel	666	PLO	1985	.
			Iran-Iraq War	39	Iran	630	Iraq	1980-1988	645
	Operation Desert Strike			45	US	2	Iraq	1996	645
	Manchuria		Second Sino-Japanese War	7	Japan	740	China	1937-1945	710
			World War II	16	Allies	2	Japan	Aug. 1945	740
	Bombing of Rotterdam		World War II	12	Germany	255	Netherlands	1940	210
	Biafran Air Force Attacks		Nigerian-Biafran War	32	Biafran Rebels	.	Nigeria	1967	475
			World War II	8	Germany	255	Britain/France	1939	200
	Operation Allied Force		Kosovo War	51	NATO	2	Yugoslavia	1999	345
			Soviet-Afghan War	36	USSR	365	Afghanistan	1979-1988	700
			Korean War	25	United States	2	North Korea/China	1950-1951	731
	Rolling Thunder		Vietnam War	31	United States	2	North Vietnam	1965-1968	816
			Second Italo-Ethiopian War	4	Italy	325	Ethiopia	1936	530
				2	Britain	200	Somali Rebels	1920	520
					Israel	666	PLO	1970-1979	.

	Tanker War		Iran-Iraq War	41	Iran	630	Saudi Arabia/Kuwait	1984-1986	670
			WWI	1	Germany	255	Britain	1917	200
			WWII	19	Allies	2	Italy	1943	325
	Kurdish Revolt			3	Britain	200	Turkey	1922-1924	640
			Spanish Civil War		Spanish Nationalists	.	Spanish Loyalists	1936-1938	.
	Polish invasion		World War II		Germany	255	Poland	1939	290
	Battle of Britain		World War II		Germany	255	Britain	Sept. 1940	200
	Battle of Britain		World War II		Britain	200	Germany	1940	255
			World War II		Britain	200	Germany	1940-1942	255
	Doolittle Raid-Pacific War		World War II		United States	2	Japan	1942	740
	Bombing of Germany 1942-1944		World War II		Allies	2	Germany	1942-1944	255
			Arab Israeli War		Egypt	651	Israel	1948	666
			Arab Israeli War		Israel	666	Egypt	1948	651
			Korean War		United States	2	North Korea/China	1953	731
			French-Algerian War		France	220	Algeria	1954-1962	615
			Suez Crisis		Britain/France	200	Egypt	1956	651
			Suez Crisis		USSR	365	Britain/France	1956	200
			Cuban Missile Crisis		United States	2	USSR	1962	365
	Linebacker I and II		Vietnam War		United States	2	North Vietnam	1972	816
	Israeli raids on Egypt		The War of Attrition		Israel	666	Egypt	1969-1970	651
			Soviet-Afghan War		USSR	365	Pakistan	1979-1986	770
			Iran-Iraq War		Iraq	645	Iran	1980-1988	630
	War of the Cities		Iran-Iraq War		Iran	630	Iraq	1987	645
	War of the Cities		Iran-Iraq War		Iraq	645	Iran	1987-1988	630
	Operation Desert Fox		Operation Desert Fox		US	2	Iraq	1998	645
	1st Russian-Chechen War		1st Russian-Chechen War		Russia	365	Chechnya	1994-1996	.
	2nd Russian-		2nd Russian-		Russia	365	Chechnya	1999	.

	Chechen War		Chechen War						
	Taiwan Strait Crisis		Taiwan Strait Crisis		China	710	Taiwan	1996	713
	Safed Sagar (White Sea)		Kargil War		India	750	Pakistan	1999	770
	Desert Storm		First Gulf War		Allies	2	Iraq	1991	645
	Operation Deliberate Force		Operation Deliberate Force		NATO	2	Serbia	1995	345
	Bombing of Saudi Arabia		Gulf War		Iraq	645	Saudi Arabia	1991	670
	Operation Enduring Freedom		Afghanistan War		US	2	Afghanistan	October 7, 2001-December 17,2001	700
	Iraq War		Iraq War		US	2	Iraq	March 20-May 1, 2003	645

Part 2

Variable	Campaign name	Campaign start date	Campaign end date	**Use of Air Power Variables**	**Use of interdiction (1,0)**	Are air operations being conducted to divert, disrupt, delay, or destroy the enemy's military potential before it can be brought to bear effectively against friendly forces or otherwise achieve objectives?	Is the distance of the use of air power far enough from friendly forces that detailed integration of the air mission with friendly forces is not required?	Are targets military resources that the enemy could have used against the nation in question?	Is air power directed against targets that are contributing to reinforcing the land battle?
Variable Name	Campaign	Start	End		Interdiction	DDD	NoIntegrate	Milresource	Reinforce
	Bombing of Dresden	2/13/1945				1	1	1	1
	Operation Peace for Galilee	1982	1985			1	0	1	1
	Operation El	4/15/1986				1	.	0	0

	Dorado Canyon								
	Blitz	8/24/1940	9/24/1940			1	1	0	0
		1/18/1991	2/28/1991			0	1	0	0
		11/30/1939	3/12/1940			0	.	0	.
	Operation Wooden Leg	10/1/1985	10/1/1985			0	1	0	0
		9/22/1980	8/20/1980			1	0	1	1
	Operation Desert Strike	9/3/1996	9/4/1996			1	1	1	0
	Manchuria	7/7/1937	9/9/1945			0	1	0	0
		8/6/1945	8/9/1945			0	1	0	0
	Bombing of Rotterdam	5/13/1940	5/14/1940			1	1	0	0
	Biafran Air Force Attacks					1	1	1	1
		.	.	.	.	.	.	.	.
	Operation Allied Force	3/24/1999	6/10/1999			0	1	0	0
						0	0	0	0
						1	1	1	0
	Rolling Thunder	2/24/1965	10/31/1968			1	0	1	1
		10/2/1935	5/5/1936						
						1	1	1	1
	Tanker War	5/13/1984	10/1/1987			0	1	0	0
		5/23/1917	10/1/1917			0	1	0	0
		10/1/1942	8/1/1943			0	1	0	0
	Kurdish Revolt	10/22/1922	6/1/1923			0	1	0	0
		8/14/1936	9/29/1938			0	0	1	1
	Polish invasion	9/1/1939	9/27/1939			0	1	0	0
	Battle of Britain	7/10/1940	10/31/1940			1	1	1	0
	Battle of Britain	7/10/1940	10/31/1940			1	1	1	0
		7/1/1941	6/1/1942			0	1	0	0
	Doolittle Raid-Pacific War	4/18/1942	12/15/1942			1	1	1	1
	Bombing of Germany 1942-1944	1/1/1942	12/31/1944			0	1	0	0
		5/15/1948	2/24/1949			0	1	0	0
		5/31/194				1	1	1	1

		8							
		11/1/1954	3/19/1962			1	0	1	1
		10/31/1956	11/6/1956			1	1	1	0
	Lineback er I and II	5/10/1972	1/27/1973			1	1	1	1
	Israeli raids on Egypt	20/07/1969	4/1/1970			0	1	1	1
		1/1/1979	12/31/1986			1	1	1	1
		9/22/1980	6/1/1988	1		1	1	1	0
	War of the Cities	2/6/1987	4/20/1987			0	1	0	0
	War of the Cities	2/7/1987	7/15/1987			1	1	1	0
	Operatio n Desert Fox	12/17/1998	12/20/1998			1	1	1	0
	1st Russian-Chechen War	12/11/1994	8/31/1996			1	1	1	1
	2nd Russian-Chechen War	9/24/1999	2/15/2000			1	1	1	1
	Taiwan Strait Crisis	6/18/1905	6/18/1905			.	.	.	.
	Safed Sagar (White Sea)	5/26/1999	7/18/1999			1	1	1	1
	Desert Storm	1/19/1991	2/28/1991			1	1	1	1
	Operatio n Deliberat e Force	8/29/1995	9/14/1995			1	0	0	1
	Bombing of Saudi Arabia	1/18/1991	2/28/1991			0	1	0	0
	Operatio n Enduring Freedom	10/7/2001	3/2/2002			1	1	1	1
	Iraq War	3/20/2003	5/1/2003			1	1	1	1

Part 3

Variab le	Campaig n name	Is the aim of the attack to cut off ground	Are the targets lines of communicati on whose destruction	**Use of close air suppo rt (1,0)**	Is the air action against hostile targets	Is detailed integrati on of missions with	Is the attack carried out at a range from the	Is air power being used in preparati on for	Is air power being used as reinforceme nt of attacks on

		forces from command and supply lines in order to make them more vulnerable to attack?	would impede the movement of the enemy's forces (for examples, bridges or highways that the enemy needs to cross in order to conduct an attack)?		that are in close proximity to friendly forces?	friendly ground forces required?	battlefield within which terminal attack control is required for fratricide prevention?	battle?	the ground?
Variable Name	Campaign	CutOff	Movement	CAS	Proximity	Integration	TAC	Prep	ReinforceCAS
	Bombing of Dresden	0	1		0	0	0	0	0
	Operation Peace for Galilee	0	0	1	1	1	1	1	1
	Operation El Dorado Canyon	0	0		0	0	0	0	0
	Blitz	0	0		0	0	0	0	0
		0	0		0	0	0	0	0
		0	0		1	.	.	1	1
	Operation Wooden Leg	0	0		0	0	0	0	0
		1	0		.	0	0	0	1
	Operation Desert Strike	0	0		0	0	0	0	0
	Manchuria	0	0		0	0	0	0	0
		0	0		0	0	0	0	0
	Bombing of Rotterdam	0	0		0	0	0	1	1
	Biafran Air Force Attacks	0	0						
		.	.	.	.	.	.	.	.
	Operation Allied Force	0	1		0	0	0	0	0
		0	0		1	1	1	1	1
		1	1		1	.	.	1	1
	Rolling Thunder	0	1		1	1	0	1	1
					1	0	0	1	1
		0	0		0	0	0	1	1
	Tanker War	0	0		0	0	0	0	0
		0	0		0	0	0	0	0
		0	0		0	0	0	0	0
	Kurdish Revolt	0	0		0	0	0	1	1

		0	0		1	0	0	1	1
	Polish invasion	1	1		1	1	1	1	1
	Battle of Britain	0	0		0	0	0	1	0
	Battle of Britain	0	0		0	0	0	0	0
		0	0		0	0	0	0	0
	Doolittle Raid-Pacific War	0	0		0	0	0	0	0
	Bombing of Germany 1942-1944	0	0		0	0	0	0	0
		0	0		1	1	1	1	1
		0	0		0	0	0	1	1
		1	0		1	1	1	1	1
		0	1		0	0	0	1	1
	Lineback er I and II	1	1		0	0	0	1	1
	Israeli raids on Egypt	0	1		1	0	0	0	0
		0	0		0	0	0	0	0
		0	0		0	0	0	1	1
	War of the Cities	0	0		0	0	0	0	0
	War of the Cities	0	0		0	0	0	0	0
	Operatio n Desert Fox	0	0		0	0	0	0	0
	1st Russian-Chechen War	0	1		1	1	1	1	1
	2nd Russian-Chechen War	1	0		1	1	1	1	1
	Taiwan Strait Crisis	.	.	.	.	.	.	.	.
	Safed Sagar (White Sea)	1	1		1	1	1	1	1
	Desert Storm	1	1		0	0	0	1	0
	Operatio n Deliberat e Force	1	1		0	1	1	0	1
	Bombing of Saudi Arabia	0	0		0	0	0	0	0
	Operatio n Enduring	1	0		1	1	1	1	1

	Freedom								
	Iraq War	0	0		1	1	1	1	1

Part 4

Variable	Campaign name	**Use of strategic attack (1,0)**	Is the aim of the attack to affect the enemy's leadership, conflict-sustaining resources and strategy?	Is the use of air power aimed at destroying resources that will weaken the enemy and its ability to prosecute the war?	Is the attack carried out at a large distance from the battlefield	Does the attack aim to target the enemy's sources of strength without first having to engage military forces?	Is the attack intended to attack the enemy as a system, not just on the battlefield?	Dominant use interdiction (1,0)
Variable Name	Campaign	Strategic	Leader	Weaken	Longdistance	Sources	System	DomInterdiction
	Bombing of Dresden		0	1	1	1	1	1
	Operation Peace for Galilee		0	0	0	0	0	1
	Operation El Dorado Canyon		0	1	0	1	1	0
	Blitz		1	1	1	1	1	0
			0	0	1	0	0	
			0	0	0	0	0	0
	Operation Wooden Leg		1	0	1	1	1	0
			1	1	1	1	1	0
	Operation Desert Strike		1	0	1	1	0	0
	Manchuria		1	1	1	1	1	0
			0	1	1	1	1	0
	Bombing of Rotterdam		1	1	0	1	1	0
	Biafran Air Force Attacks		0	0	0	1	1	1
		.	.	.	.	.	.	.
	Operation Allied Force		1	1	1	1	1	0
			1	1	1	1	1	0
			0	1	1	1	1	1
	Rolling Thunder		1	1	0	1	1	1
					0	0	1	0
			1	1	0	0	0	1
	Tanker War		0	1	1	1	1	0
			0	0	1	1	1	0

			0	0	1	1	1	0
	Kurdish Revolt		1	1	1	1	1	0
			0	0	1	0	0	0
	Polish invasion		0	0	1	1	1	0
	Battle of Britain		1	1	1	1	1	0
	Battle of Britain		1	1	1	0	1	1
			0	1	1	1	1	0
	Doolittle Raid-Pacific War		0	0	1	0	1	1
	Bombing of Germany 1942-1944		0	1	1	1	1	0
			0	0	1	0	1	0
			0	0	1	1	1	1
			0	1	0	0	0	1
			0	1	1	1	0	1
	Linebacker I and II		1	1	1	1	1	1
	Israeli raids on Egypt		1	1	1	1	1	1
			0	0	1	0	0	1
			1	1	1	0	1	1
	War of the Cities		0	0	1	1	1	0
	War of the Cities		1	1	1	1	1	0
	Operation Desert Fox		1	1	1	1	1	0
	1st Russian-Chechen War		0	0	0	1	0	1
	2nd Russian-Chechen War		0	0	0	1	0	1
	Taiwan Strait Crisis	.	.	.	.	.	.	.
	Safed Sagar (White Sea)		1	1	0	0	0	1
	Desert Storm		1	1	1	1	1	1
	Operation Deliberate Force		1	0	1	1	0	1
	Bombing of Saudi Arabia		0	0	1	1	1	0
	Operation Enduring Freedom		1	1	1	0	0	1
	Iraq War		1	0	1	1	1	1

Part 5

Variable	Campaign name	Dominant use CAS (1,0)	Dominant use strategic (1,0)	**Modern Air Power Variables**	**Modern Air Power (1,0)**	**In the case of interdiction**	Are the targets non-military (e.g. roads, warehouses)?	Are lines of communication and transportation (bridges, highways) being targeted?	Are defenses avoided (going directly to center of gravity)?
Variable Name	Campaign	DomCAS	DomStrategic		ModAir		NonMilTar	Comm	DefenseAvoid
	Bombing of Dresden	0	1				1	1	.
	Operation Peace for Galilee	1	0				0	0	0
	Operation El Dorado Canyon	0	1				0	0	1
	Blitz	0	1				1	0	1
							1	0	1
		1	.				0	0	0
	Operation Wooden Leg	0	1				1	0	1
		0	1				0	0	1
	Operation Desert Strike	0	1				0	0	1
	Manchuria	0	1				1	0	1
		0	1				1	0	1
	Bombing of Rotterdam	0	1				1	0	1
	Biafran Air Force Attacks	0	0				0	0	1
		.	.	.	.	.	.	.	.
	Operation Allied Force	0	1				1	1	1
		1	1				1	0	0
		1	1				1	0	1
	Rolling Thunder	0	0				0	1	0
		1	0				0	0	0
		0	0				0	0	1
	Tanker War	0	1				1	0	1
		0	1				1	0	1
		0	1				1	0	1
	Kurdish Revolt	0	1				1	0	1
		1	1				0	0	0
	Polish invasion	1	1				1	1	0
	Battle of	0	1				1	0	0

	Britain								
	Battle of Britain	0	1				1	0	0
		0	1				1	0	1
	Doolittle Raid-Pacific War	1	0				0	0	0
	Bombing of Germany 1942-1944	0	1				1	0	0
		0	1				1	0	1
		1	1				0	0	0
		1	0				0	0	0
		0	1				0	0	0
	Linebacker I and II	0	1				1	1	1
	Israeli raids on Egypt	0	1				1	1	1
		0	0				0	0	0
		0	1				0	0	0
	War of the Cities	0	1				1	0	1
	War of the Cities	0	1				1	0	1
	Operation Desert Fox	0	1				0	0	1
	1st Russian-Chechen War	1	0				1	1	1
	2nd Russian-Chechen War	1	0				0	0	0
	Taiwan Strait Crisis	.	.	.		.	.	.	.
	Safed Sagar (White Sea)	1	0				0	0	0
	Desert Storm	0	1				1	1	1
	Operation Deliberate Force	1	1				1	1	0
	Bombing of Saudi Arabia	0	1				1	0	1
	Operation Enduring Freedom	1	1				0	0	0
	Iraq War	1	1				0	0	1

Part 6

Variable	Campaign name	Can defenses be avoided in this situation?	Is the support infrastructure (supply lines) being targeted?	Is the aim of the attack to create a temporary window of opportunity that can be taken advantage of by ground forces?	Are non-combat military units, such as headquarters, being targeted?	Is the source of troops or materiel being targeted?	**In the case of strategic**	Are centers of gravity being targeted?	Does the attack cause a limited amount of indirect collateral damage and not have a long-term impact on the civilian economy?
Variable Name	Campaign	CanAvoid	SupplyLine	Window	HQ	SourceTar		CenGravity	SmallCollateral
	Bombing of Dresden	.	1	0	0	1		.	0
	Operation Peace for Galilee	1	0	0	1	1		0	0
	Operation El Dorado Canyon	1	0	0	0	1		0	1
	Blitz	0	0	0	0	1		1	1
		1	0	0	0	0		0	0
		1	0	0	0	0		0	1
	Operation Wooden Leg	1	0	0	1	0		1	1
		1	1	0	0	1		1	0
	Operation Desert Strike	1	1	0	1	1		1	1
	Manchuria	1	0	0	0	1		1	0
		1	0	0	0	0		0	0
	Bombing of Rotterdam	1	0	0	0	0		1	0
	Biafran Air Force Attacks	1	0	0	0	1		1	1
		.	.	.	.	.	.	.	.
	Operation Allied Force	1	1	0	1	1		1	0
		1	0	0	0	0		0	0
		1	1	0	0	1		1	0
	Rolling Thunder	0	1	0	0	1		1	1
		1	0	0	0	0		0	0
		1	0	0	0	1		1	1

	Tanker War	1	1	0	0	0		0	1
		1	0	0	0	0		1	0
		1	0	0	0	0		0	0
	Kurdish Revolt	1	0	0	0	0		0	0
		1	1	1	0	1		0	0
	Polish invasion	1	0	0	0	0		0	0
	Battle of Britain	0	0	0	1	1		1	0
	Battle of Britain	0	0	0	0	1		1	1
		1	0	0	0	0		0	0
	Doolittle Raid-Pacific War	0	0	0	0	0		0	1
	Bombing of Germany 1942-1944	0	0	0	0	0		1	0
		1	0	0	0	0		0	0
		1	0	0	0	0		0	1
		1	1	1	0	1		0	1
		1	0	0	0	0		0	1
	Lineback er I and II	1	1	0	1	1		1	1
	Israeli raids on Egypt	1	0	0	0	1		1	1
		1	0	0	0	0		0	1
		1	0	0	0	1		1	1
	War of the Cities	1	0	0	0	0		0	0
	War of the Cities	1	0	0	1	1		1	0
	Operatio n Desert Fox	1	0	0	1	1		0	1
	1st Russian-Chechen War	1	0	0	0	0		0	1
	2nd Russian-Chechen War	1	1	0	0	0		0	1
	Taiwan Strait Crisis	.	.	.	.	.	.	.	.
	Safed Sagar (White Sea)	1	1	0	1	0		0	1
	Desert Storm	1	1	0	1	1		1	0
	Operatio n Deliberat	1	1	0	1	0		0	1

	e Force								
	Bombing of Saudi Arabia	1	0	0	0	0		0	1
	Operation Enduring Freedom	1	1	0	1	1		0	1
	Iraq War	1	0	0	1	1		0	1

Part 7

Variable	Campaign name	Can the attack be carried out without causing collateral damage and impacting the civilian economy?	Are targets selected to impair the enemy's ability to wage war but continue non-military production without much disturbance?	Can targets be selected to impair the enemy's ability to wage war but continue non-military production without much disturbance?	If there is aerial bombing used, is it on targets away from the enemy's homeland?	**In the case of CAS**	Is CAS used only at decisive points in a battle?	Is CAS massed to apply concentrated combat power and saturate defenses?	Is CAS used against targets that are beyond the range of troops in contact?
Variable Name	Campaign		ImpairWar		NotHomeland		Decisive	Massed	LongRange
	Bombing of Dresden		0		0		0	0	0
	Operation Peace for Galilee	0	0	1	0		0	0	0
	Operation El Dorado Canyon	1	1	1	0		0	0	0
	Blitz	1	1	1	0		0	0	0
		1	0	1	0		0	0	0
		1	0	1	0		1	1	0
	Operation Wooden Leg	1	1	1	1		0	0	0
		1	0	1	0		.	.	.
	Operation Desert Strike	1	1	1	0		0	0	0
	Manchuria	1	0	1	0		.	.	.
		1	0	1	0		.	.	.
	Bombing of Rotterdam	0	1	1	0		.	.	.
	Biafran Air Force Attacks	1	1	1	0				
		.	.	.	.	.	.	.	.
	Operation Allied Force	1	0	0	0		.	.	.
		1	0	1	0		0	1	1
		1	0	1	0		.	.	.

	Rolling Thunder	1	1	1	0		0	0	0
		1	0	1	0		0	0	0
		1	1	1	0		0	1	1
	Tanker War	1	1	1	1		0	0	0
		1	0	1	0		0	0	0
		1	0	1	0		0	0	1
	Kurdish Revolt	1	0	1	0		0	0	1
		1	0	1	0		1	1	1
	Polish invasion	1	0	1	0		0	1	0
	Battle of Britain	1	0	1	0		.	.	.
	Battle of Britain	1	1	1	0		.	.	.
		1	0	1	0		0	0	1
	Doolittle Raid-Pacific War	1	1	1	1		.	.	.
	Bombing of Germany 1942-1944	1	0	1	0		0	0	1
		1	0	0	0		.	.	0
		1	1	1	0		0	0	0
		1	1	1	0		1	1	0
		1	1	1	0		0	0	1
	Lineback er I and II	1	0	1	0		0	0	0
	Israeli raids on Egypt	1	1	1	0		0	0	1
		1	1	1	0		0	0	1
		1	1	1	0		0	0	0
	War of the Cities	1	0	1	0		0	0	1
	War of the Cities	1	0	1	0		0	0	1
	Operatio n Desert Fox	1	1	1	0		0	0	0
	1st Russian-Chechen War	1	1	1	0		0	0	0
	2nd Russian-Chechen War	1	0	1	0		1	1	0
	Taiwan Strait Crisis	.	.	.	.		.	.	.
	Safed Sagar (White Sea)	1	1	1	1		0	0	0
	Desert Storm	1	1	1	0		.	.	.
	Operatio n	1	1	1	0		1	1	1

	Deliberate Force								
	Bombing of Saudi Arabia	1	0	1	0		0	0	0
	Operation Enduring Freedom	1	1	1	0		1	1	0
	Iraq War	1	1	1	0		0	1	1

Part 8

Variable	Campaign name	Does CAS provide selective and discriminating firepower?	Can selective and discriminating power be applied in these circumstances?	**Non-Modern Air Power (1,0)**	**In the case of interdiction**	Are combat forces (ie the actual troops, tanks, etc) NOT being targeted?	Are vehicles used to transport troops or supplies along the the conduit NOT being targeted?	Is the aim of interdiction NOT the attrition of enemy forces and materiel?	Is air power NOT being used to slow down and enemy that is pursuing forces in retreat?
Variable Name	Campaign	Selective	CanSelective	NonModAir		MilTar	TroopTrans	Attrition	Retreat
	Bombing of Dresden	0				1	0	1	1
	Operation Peace for Galilee	1	1			0	1	0	1
	Operation El Dorado Canyon	0	1			0	1	0	1
	Blitz	0	0			1	1	1	1
		0	1			1	1	1	1
		0	1			0	1	0	1
	Operation Wooden Leg	0	0			1	1	1	1
		.	.			0	1	0	1
	Operation Desert Strike	0	0			0	1	0	1
	Manchuria	.	.			1	1	1	1
		.	.			1	1	1	1
	Bombing of Rotterdam	.	.			1	1	0	1
	Biafran Air Force Attacks					0	0	0	1
		.	.	.	.	.	.	.	.
	Operatio	.	.			1	1	1	1

	n Allied Force								
		1	1			0	1	0	1
		.	.			0	0	0	1
	Rolling Thunder	1	1			0	.	0	1
		0	0			0	1	0	1
		0	0			0	0	0	0
	Tanker War	0	0			1	1	1	1
		0	0			0	1	1	1
		0	.			1	1	1	1
	Kurdish Revolt	0	1			1	1	1	1
		1	1			0	0	0	1
	Polish invasion	0	1			0	1	0	1
	Battle of Britain	.	.			0	1	0	1
	Battle of Britain	.	.			0	0	0	1
		0	0			1	1	1	1
	Doolittle Raid-Pacific War	.	.			0	0	0	1
	Bombing of Germany 1942-1944	1	1			1	1	1	1
		0	1			1	1	1	1
		0	0			0	1	0	1
		1	1			0	1	0	1
		1	1			0	0	0	1
	Lineback er I and II	0	1			0	0	0	1
	Israeli raids on Egypt	1	1			0	1	0	1
		0	1			0	1	0	1
		0	0			0	1	0	1
	War of the Cities	0	0			1	1	1	1
	War of the Cities	1	1			0	0	0	1
	Operatio n Desert Fox	0	1			0	1	0	1
	1st Russian-Chechen War	0	1			1	0	0	1
	2nd Russian-Chechen War	1	1			0	1	0	1
	Taiwan Strait Crisis	.	.			.	.	.	.
	Safed	0	0			0	1	0	1

	Sagar (White Sea)								
	Desert Storm	.	1			1	1	0	1
	Operation Deliberate Force	1	1			0	1	0	1
	Bombing of Saudi Arabia	0	1			1	1	1	1
	Operation Enduring Freedom	1	1			0	0	0	1
	Iraq War	1	1			0	0	0	1

Part 9

Variable	Campaign name	**In the case of CAS**	Could this attack NOT have been carried out by artillery?	Was this attack NOT aerial bombardment of the enemy line?	Was the attack NOT preparatory to an offensive?	Does the attack NOT involve air strikes on troops "crossing the wire"?	Is air NOT being used to hold a flank?	**In the case of strategic**	Is the enemy's homeland NOT targeted?
Variable Name	Campaign		Artillery	Line	PrepOffense	WireCross	Flank		Homeland
	Bombing of Dresden		1	1	0	1	1		0
	Operation Peace for Galilee		0	0	0	1	1		0
	Operation El Dorado Canyon		1	1	1	1	1		0
	Blitz		1	1	1	1	1		0
			1	1	1	1	1		0
			0	0	0	1	1		0
	Operation Wooden Leg		1	1	1	1	1		1
			.	0	.	1	.		0
	Operation Desert Strike		1	1	1	1	1		0
	Manchuria		1	1	1	1	1		0
			1	1	1	1	1		0
	Bombing of Rotterdam		1	1	0	1	1		0
	Biafran Air Force Attacks		1						0
		.	.	.	.	.	.	.	.
	Operation Allied Force		.	.	.	.	.		0
			1	0	0	1	1		0
			.	0	0	.	.		0
	Rolling		1	1	1	1	1		0

	Thunder								
			0	0	0	1	1		0
			0	0	0	1	1		0
	Tanker War		1	1	1	1	1		1
			1	1	1	1	1		0
			1	1	1	1	1		0
	Kurdish Revolt		1	1	0	1	1		0
			1	0	0	1	1		0
	Polish invasion		0	0	0	1	1		0
	Battle of Britain		1	1	0	1	1		0
	Battle of Britain		1	1	1	1	1		0
			1	1	1	1	1		0
	Doolittle Raid-Pacific War		1	1	1	1	1		1
	Bombing of Germany 1942-1944		1	1	1	1	1		0
			0	1	0	1	1		0
			0	1	0	0	1		0
			1	1	0	1	1		0
			1	1	0	1	1		0
	Linebacker I and II		0	1	0	0	1		0
	Israeli raids on Egypt		0	0	1	1	1		0
			0	1	1	1	1		0
			0	0	0	0	1		0
	War of the Cities		1	1	1	1	1		0
	War of the Cities		1	1	1	1	1		0
	Operation Desert Fox		1	1	1	1	1		0
	1st Russian-Chechen War		0	1	0	1	1		0
	2nd Russian-Chechen War		0	0	0	1	1		0
	Taiwan Strait Crisis		.	.	.	.	.		.
	Safed Sagar (White Sea)		1	0	0	0	1		1
	Desert Storm		1	1	0	1	1		0
	Operation Deliberate Force		1	1	1	1	1		0
	Bombing		1	1	1	1	1		0

	of Saudi Arabia								
	Operation Enduring Freedom		1	0	0	1	1		0
	Iraq War		1	0	0	0	1		0

Part 10

Variable	Campaign name	If fighting is not occurring in the enemy's homeland, is the homeland still NOT being targeted?	Are civilians NOT being targeted?	Are non-industrial urban areas NOT being targeted?	Is the campaign NOT punitive in character?	Modern CAS Total	Modern Interdiction Total	Modern Strategic Total	If fighting is not occurring in the enemy's homeland, is the homeland still NOT being targeted?
Variable Name	Campaign	Homeland1	CivilianTar	NonIndusTar	Punitive	ModCASTot	ModIntTot	ModStrTot	Homeland1
	Bombing of Dresden	0	0	0	0	4	7	0	0
	Operation Peace for Galilee	1	0	0	1	4	5	3	1
	Operation El Dorado Canyon	1	1	1	0	6	5	7	1
	Blitz	0	1	1	1	5	7	8	0
		0	0	0	0	6	7	2	0
		1	0	0	0	5	3	4	1
	Operation Wooden Leg	1	0	0	0	5	8	8	1
		1	0	0	0	1	6	4	1
	Operation Desert Strike	0	1	1	0	5	7	7	0
	Manchuria	1	0	0	0	5	8	4	1
		0	0	0	0	5	7	2	0
	Bombing of Rotterdam	1	0	0	0	4	6	4	1
	Biafran Air Force Attacks	1	1	1	1	1	4	9	1
		.	.	.	.	0	0	0	.
	Operation Allied Force	1	1	1	1	0	11	6	1
		1	0	0	0	7	4	3	1
		1	1	1	0	0	6	6	1
	Rolling Thunder	1	1	1	1	7	4	9	1
		1	0	1	0	2	3	4	1
		1	0	0	1	4	3	7	1

						0	0	0	
	Tanker War	1	0	1	1	5	8	9	1
		0	0	0	0	5	6	3	0
		1	0	0	0	6	7	3	1
	Kurdish Revolt	1	0	0	0	6	7	3	1
		1	0	0	0	8	5	3	1
	Polish invasion	1	0	0	0	4	5	3	1
	Battle of Britain	0	0	0	0	4	5	3	0
	Battle of Britain	0	0	0	0	5	3	5	0
		0	0	0	0	6	7	2	0
	Doolittle Raid-Pacific War	1	1	1	1	5	1	10	1
	Bombing of Germany 1942-1944	0	0	0	0	8	5	3	0
		1	0	0	0	4	7	2	1
		0	0	0	0	2	3	4	0
						0	0	0	
		1	1	1	1	8	6	8	1
		1	1	1	1	7	2	8	1
						0	0	0	
						0	0	0	
	Lineback er I and II	1	1	1	1	3	8	8	1
	Israeli raids on Egypt	1	1	1	1	6	7	9	1
		0	0	0	0	6	3	4	0
		1	1	1	1	1	4	9	1
	War of the Cities	1	0	0	0	6	7	3	1
	War of the Cities	1	0	1	0	8	6	5	1
	Operatio n Desert Fox	0	1	1	1	6	6	7	0
	1st Russian-Chechen War	1	1	1	1	4	6	8	1
	2nd Russian-Chechen War	1	0	0	1	6	4	5	1
	Taiwan Strait Crisis	.	.	.		0	0	0	.
	Safed Sagar (White Sea)	1	1	1	1	2	5	10	1
	Desert Storm	1	1	1	1	5	10	8	1
	Operatio n Deliberat	1	1	1	1	10	7	8	1

	e Force								
	Bombing of Saudi Arabia	0	0	0	0	6	7	3	0
	Operation Enduring Freedom	1	1	1	1	7	5	8	1
	Iraq War	1	1	1	1	6	5	8	1

Part 11

Variable	Campaign name	Target Use of Air	Does the campaign have limited aims?	Are defenses avoided?	Can defenses be avoided?	Is the aim of a campaign to seize a strategically important piece of terrain?	Is the aim of the attack to exploit temporary advantage/ windows of opportunity?	Is cover and concealment (NOT quasi-permanent trench lines, irregular, camouflaged locations, interlocking fields of fire) an important part of the strategy?	Are large formations broken up (dispersion)?
Variable Name	Campaign	TargetAir	LimAimsGR	DefAvoidGR	CanDefAvoidGR	TerrainGR	TempGR	CoverGR	DispersionGR
	Bombing of Dresden	1	0	1	1	1	1	1	1
	Operation Peace for Galilee	1	1	0	1	0	0	0	0
	Operation El Dorado Canyon	0	.	.	.	.	.	.	.
	Blitz	1	0	1	1	1	1	1	1
		.	0	0	1	0	0	0	0
		1	0	0	1	0	0	0	0
	Operation Wooden Leg	0	.	.	.	.	.	.	.
		1	0	0	1	0	0	0	0
	Operation Desert Strike	0	.	.	.	.	.	.	.
	Manchuria	1	0	1	1	1	0	0	.
		1	1	0	0	1	0	1	1
	Bombing of Rotterdam	1	0	1	1	1	1	1	1
	Biafran	1	1	1	1	1	1	1	1

	Air Force Attacks								
		.	.	.	.	.	.	.	.
	Operation Allied Force	1	.	.	.	.	.	.	.
		0	0	1	1	1	1	1	1
		1	0	0	1	0	0	0	0
	Rolling Thunder	1	1	0	0	0	0	1	.
		1	0	0	0	0	0	0	0
		0	1	0	1	0	0	0	
	Tanker War	0	0	0	1	0	0	0	0
		1	0	0	0	0	1	0	1
		1	0	0	.	1	1		1
	Kurdish Revolt	0							
		1	0	0	1	0	0	0	0
	Polish invasion	1	0	0	.	0	1	0	1
	Battle of Britain	1	.	.	.	.	.	.	.
	Battle of Britain	1	.	.	.	.	.	.	.
		1							
	Doolittle Raid-Pacific War	1	0	0	0	1	0	0	0
	Bombing of Germany 1942-1944	1							
		1	0	0	0	0	0	0	0
		1	0	0	0	0	0	0	1
		0	0	0	1	0	0	1	1
		0	1	0	1	1	1	0	1
	Linebacker I and II	?	1	1	1	0	0	0	1
	Israeli raids on Egypt	1	1	1	1	1	0	0	0
		1							
		1	0	0	1	1	1	0	1
	War of the Cities	1	1	1	1	1	1	1	1
	War of the Cities	1	0	0	0	0	0	0	0
	Operation Desert Fox	1	.	.	.	.	.	.	.
	1st Russian-Chechen War	0	1	1	1	1	0	0	0

	2nd Russian - Chechen War	0	0	1	1	0	0	0	1
	Taiwan Strait Crisis								
	Safed Sagar (White Sea)	0	1	0	0	1	0	0	0
	Desert Storm	0	1	0	1	0	1	0	0
	Operation Deliberate Force	0	.	.	.	.	.	.	.
	Bombing of Saudi Arabia	0	.	.	.	.	.	.	.
	Operation Enduring Freedom	0	1	0	1	1	0	0	1
	Iraq War	0	1	0	1	1	0	0	1

Part 12

Variable	Campaign name	Are subunits (platoons or sections, not battalions or companies) allowed to move independently?	Is the whole operation NOT orchestrated from above?	Does terrain allow subunits to move independently?	Is suppressive fire emphasized over destructive fire?	Is there combined arms integration (teaming together weapon types with contrasting strengths and weaknesses like infantry and artillery)?	Is the aim to induce the systemic collapse of a defense while fighting through only a fraction of it directly?	Are targets the support infrastructre (supply lines)?	Are forces disproportionately concentrated at a given point?
Variable Name	Campaign	SmallGR	AboveGR	TerrainIndepGR	SuppressGR	CombinedGR	FracrtionGR	SupportGR	ConcentrateGR
	Bombing of Dresden	1	0	1	.	1	.	0	1
	Operation Peace for Galilee	0	0	1	.	1	0	1	0
	Operation El Dorado	.	.	.	.	.	.	.	.

	Canyon								
	Blitz	0	0	1	.	1	1	0	1
		0	0	1	.	.	0	0	0
		0	0	1	0	0	0	0	1
	Operation Wooden Leg	.	.	.	.	.	.	.	.
		0	0	1	.	.	0	0	0
	Operation Desert Strike	.	.	.	.	.	.	.	.
	Manchuria	.	0	1	.	1	0	0	0
		0	0	0	0	0	1	0	1
	Bombing of Rotterdam	1	0	1	.	.	1	0	1
	Biafran Air Force Attacks	1	1	1	.	.	1		1
		.	.	.	.	.	.	.	.
	Operation Allied Force	.	.	.	.	.	.	.	.
		0	0	1	1	1	0	0	
		1	0	0	.	1	0	1	1
	Rolling Thunder	0	0	1	0	1	1	1	1
		0	0	1	0	.	0	0	0
				1	0	1	0	1	1
	Tanker War	0	0	1	.	.	0	0	0
		1	0	1	1	.	0	0	.
		1	0	1			1	0	1
	Kurdish Revolt								
		0	0	1	0	1	0	0	0
	Polish invasion	1	0	1	.	1	1	0	1
	Battle of Britain	.	.	.	.	.	.	.	.
	Battle of Britain	.	.	.	.	.	.	.	.
	Doolittle Raid-Pacific War	1	0	0	0	1	1	0	0
	Bombing of Germany 1942-1944								
		0	0	1	1	.	0	1	1
		1	1	1	1	1	0	0	0
		1	1	1	0	1	0	0	1

		1	0	1	0	1	1	0	1
	Lineba cker I and II	1	0	1	0	1	0	0	1
	Israeli raids on Egypt	1	0	1	0	1	1	0	1
		1	0	1	0	1	1	0	1
	War of the Cities	1	0	1	.	1	1	0	1
	War of the Cities	0	0	.	0	0	0	0	0
	Operati on Desert Fox	.	.	.	.	.	.	.	.
	1st Russia n-Cheche n War	0	0	1	0	0	1	0	1
	2nd Russia n-Cheche n War	1	1	1	0	1	0	0	0
	Taiwan Strait Crisis								
	Safed Sagar (White Sea)	1	1	1	0	0	0	1	1
	Desert Storm	1	0	1	.	.	0	0	1
	Operati on Deliber ate Force	.	.	.	.	.	.	.	.
	Bombin g of Saudi Arabia	.	.	.	.	.	.	.	.
	Operati on Endurin g Freedo m	1	0	1	0	1	1	0	1
	Iraq War	1	0	1	0	1	1	0	1

Part 13

Variabl e	Campaig n name	Is depth emphasized over density when establishing	**Source**	Source (for ground strategy)

		defense?		
Variable Name	Campaign	DepthGR	Source	SourceGR
	Bombing of Dresden	.	*Swanston, Alexander & Malcolm Swanston. 2009. Atlas of Air Warfare: The History of Aerial Combat. Fall River Press: New York. *Dear, I.C.B., ed. 2005. The Oxford Companion to World War II. Oxford University Press: Oxford. **Swanston, Alexander & Malcolm Swanston. 2007. The Historical Atlas of World War II. Chartwell Books: Edison, NJ.	*The Historical Atlas of WWII
	Operation Peace for Galilee	.	*www.globalsecurity.org (http://www.globalsecurity.org/military/library/report/1987/SGC.htm)	*Allen 2007
	Operation El Dorado Canyon	.	*www.globalsecurity.org (http://www.globalsecurity.org/military/ops/el_dorado_canyon.htm)	
	Blitz	.	*Swanston & Swanston 2009	*Dear 2005
		0	*(http://www.jewishvirtuallibrary.org/jsource/History/Gulf_War.html) *(http://news.bbc.co.uk/onthisday/hi/dates/stories/january/18/newsid_4588000/4588486.stm)	* Global Security (http://www.globalsecurity.org/military/ops/desert_sabre.htm)
		.	*Swanston & Swanston 2009	*Swanson & Swanson 2009
	Operation Wooden Leg	.	*Israel Ministry of Foreign Affairs. Press Conference on the Attack (http://www.mfa.gov.il/MFA/Foreign%20Relations/Israels%20Foreign%20Relations%20since%201947/1984-1988/92%20Press%20Conference%20Following%20Israel%20Air%20Force%20Att)	*Israeli Ministry of Foreign Affairs
		.	*Global Security (http://www.globalsecurity.org/military/world/war/iran-iraq.htm)	*Global Security (http://www.globalsecurity.org/military/world/war/iran-iraq.htm)
	Operation Desert Strike	.	*Global Security (http://www.globalsecurity.org/military/ops/desert_strike.htm)	
	Manchuria	.	*Swanston & Swanston 2009	*http://www.historylearningsite.co.uk/china_war.htm
		.	*Swanston & Swanston 2007	*Swanson & Swanson 2007
	Bombing of Rotterdam	.	*Dear & Foot 2005	*Dear & Foot 2005
	Biafran Air Force Attacks		*Biafra: How to Build an Instant Air Force. June 6, 1969. Time Magazine. http://www.time.com/time/magazine/article/0,9171,941667-1,00.html	*http://www.globalsecurity.org/military/world/war/biafra.htm
		.	Allen 2007	.
	Operation Allied Force	.	www.nato.int (operation allied force) http://www.nato.int/kosovo/history.htm	.
		1	McMichael, Scott. 1991. Stumbling Bear: Soviet Military Performance in Afghanistan. Brassey's, London.	*McMichael 1991
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